PERFORMANCE ASSESSMENT OF SURFACE MINER IN INDIAN COAL MINES

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF

MASTER OF TECHNOLOGY (DUAL DEGREE)
IN
MINING ENGINEERING

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Rourkela- 769008
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2015

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2015

CERTIFICATE

This is to certify that, the thesis entitled "*PERFORMANCE ASSESSMENT OF SURFACE MINER IN INDIAN COAL MINES*" submitted by Sri Seethiraju Eswar Nandan in partial fulfilment of the requirements for the award of Master of Technology (Dual degree) in Mining Engineering at National Institute of Technology is an authentic work carried out by him under my supervision and guidance.

To the best of my knowledge, the matter embodied in the report has not been submitted to any University/Institute for the award of any Degree or Diploma.

Date: 10/05/2012

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ABSTRACT

Over the past few decades, opencast coal mining in India has become more prevalent than underground mining, this is mainly because of rising demand for coal. So, in order to fulfil this rising demand, application of larger equipment's (Dragline, BWE, Surface-miner etc.) in opencast mines has grown significantly. Surface miner is one such equipment which is becoming more popular day by day because of its application in mines where conventional mining is prohibited or in mines where selective mining is required and it also have advantages like less mineral loss, better mineral recovery and better fragmentation of minerals. Globally in different mines around 300 surface miners of different make and specifications are being used for mining of minerals. In Indian Mines, Surface Miners have been introduced in 1996, so, it is still a relatively new technology. It involves intensive capital investment i.e. its initial cost of deployment is high. In order to compensate its high cost, productivity should be improved so that cost per tonne of production will be low and the mine operates profitably. In order to improve the productivity we need to utilize the surface miner as effectively as possible. Therefore, the precise estimation of equipment effectiveness plays a key role in increasing the productivity. There may be a number of measures available, which are used to indicate performance using different parameters. But, the most commonly used measure to determine performance against ability of the equipment is Overall Equipment Effectiveness which is often referred to as OEE. It uses parameters like availability, performance and quality for the estimation of equipment effectiveness.

Key words: *Surface Miner; Performance; Productivity; Utilization; Availability; Equipment Effectiveness*

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CHAPTER 1

INTRODUCTION

1 INTRODUCTION

Mining is a very capital-intensive industry, and it is well known fact that the equipment availability and precise estimation of its utilization are very important because mine managers want to utilize their equipment as effectively as possible to get an early return on their investments as well reducing total production cost. While a lot of thrust is put on the selection of mining equipments not much consideration is paid towards the measurement of effectiveness of those equipments. The increase in automation, compounded by the increase in the size and capacity of equipment over the years has drastically changed the consequences of equipment ineffectiveness. In the present economic conditions, severe global competition, challenges of environmental and safety considerations, in order to achieve high production and productivity of HEMMs in opencast mines, it is pertinent to have high % availability and % utilization of equipments besides ensure overall equipment effectiveness vis-à-vis established CMPDI norms/global bench marks. This necessitates performance assessment of various equipments in highly mechanized OCPs, critically analyse the idle/down time of equipments and take ameliorative measures to improve machine productivity and performance.

OEE is a tool which evaluate and indicates how effectively a production operation is utilized .Utilization of equipments can be only be improved and maintained successfully if an appropriate performance measurement system is used. One should also try to identify unproductive time losses within the system as these time losses affect availability, performance and quality. The consequence of proper data collecting system to estimate equipment effectiveness is also emphasized.

In Indian surface mining industry, surface miners made their debut in 1996. Presently, around 105 surface miners are working in Indian coal and limestone mines. The surface miners are being deployed largely on trial and error basis and the investors are interested in field experimental runs. The applicability of surface miners is evaluated by the manufacturers based on compressive strength of rock. In this context, it is logical to found a method to evaluate the performance of surface miners. The overall equipment effectiveness (OEE) of the surface miners has been determined to evaluate their performance.

In this project, an attempt has been made to analyse the performance of Surface miners deployed at two highly mechanized OCPs of Mahanadi Coalfields Limited (MCL).

1.1 OBJECTIVES

- To estimate % availability, % utilization and analyze idle hours of Surface Miners at Lakhanpur OCP and Sameleswari OCP.
- To determine Overall Equipment Effectiveness (OEE) of Surface Miner at LOCP and SOCP.

CHAPTER 2

LITERATURE REVIEW

2 LITERATURE REVIEW

2.1 PROJECT PROFILE OF THE MINES

2.1.1 Lakhanpur Mines

SL.NO.	INFORMATION	DATA
01	Mine Capacity	18.75 MT Coal
02.	Total Mineable Coal Reserve	416.32MT
03.	Coal Extracted till 31.03.2014	162.09 MT
04.	Balance Mineable Coal Reserve as on -01.04.14	254.23MT
05.	Expected life of the Mine	Up to 2030
06.	Stripping ratio (Avg.)	2.34 : 1 cum /Te
07.	Date of Introduction of 1st Surface Miner of MCL in Lakhanpur OCP	20.06.1999.
08.	Gradient	1 in 12 to 1 in 17
09.	Maximum Quarry Depth	165 m
10.	Total Manpower	1572 (907 Dept. +665 Contr.)
11.	Quality of Coal	87%F & 13% G
12.	Floor Area	1207 Ha.
13.	Capital outlay in Rs. /Te. of Annual Out Put	355.86 Rs. /Te.
14.	Main Customer	ITPS (OPGC)
15.	Total land Requirement	2485Ha.
16.	Forest Land	328.83 Ha.
17.	Production 2013-14(Coal)	149.99 Lakh Te.
18.	Coal Dispatch `2013-14	149.58 Lakh Te.
19.	O.B. Removal 2013-14	193.56 Lakh CuM.

GEOLOGY:

There are five coal seams in the sub block considered for the opencast mining. They are

1) Belpahar Seam

2) Parkhani Seam

3) Lajkura Seam

4) Rampur Seam

5) Ib Seam

In descending order.

In the area chosen for opencast mining under the project report for Lakhanpur Opencast Project, only Lajkura seam is proposed to be worked where the upper seams do not exist. The two seams (Rampur & IB) beneath Lajkura occur with large parting and these could be worked by Underground method after exhausting the Lajkura seam. The available dirt bands (1 to 5 in number) are combustible (carbonaceous shale) and range in thickness from 1.47 Mtrs to 6.91 Mtrs. (cumulative). One such thick band persists in the lower half of the seam throughout the block. Thickness of bands tends to increase towards south as well as towards the west of the property.

REASONS FOR DEPLOYMENT OF SURFACE MINER AT LAKHANPUR OCP:

a) Improvement of quality by selective mining of coal:

Coal in this mine is interspersed with shale & sand stone band of varying thickness because of which the product from the mine was marked as grade Lower 'F'. Presence of dirt bands (1 to 5 Nos.) is the major concern for quality deterioration of coal seam.

Figure 2.1: Interspersed dirt band in coal seam

b) Eco-friendly mining of coal:

Drilling & blasting operation on large scale produces a lot of noise, dust, vibration, fly rock formation etc. This has prompted the mining community to look for a viable alternative of rock breakage for overcoming these deficiencies & to increase the production & productivity while meeting the requirement of environmentally safe operation. Surface Miner fulfilled the required search.

c) Proximity of villages:

Ghanamal (a hemlet of Khairkuni village) and other villages are situated almost at the middle of quarry No. 1 and 2 of the mine. Due to restriction imposed by Directorate of Mines Safety, Bhubaneswar region, for carrying out blasting operation beyond 150 Mtrs. from the houses/structures,

resulted in locking up of huge amount of Coal. Since no drilling and blasting is required for coal winning with Surface Miner, not only the coal production has been enhanced tremendously but it has also changed the attitude of villagers and R&R finalization has become easy and smooth.

d) To Improve quality of coal:

No washing of coal is required to improve the quality of coal. Techno economically the coal from Surface Miner will be cheaper in view of the size of coal produced within the range of (+) 20 mm to (-) 100 mm which does not require secondary crushing. It eliminated double handling by eliminating the process of crushing. Direct dispatch from coal faces to various destinations has resulted in meeting the increased demand of coal in the country.

e) To Meet the High Demand of Coal due to growth of new industries:

Due to the industrialization policy of the State Government the demand of Coal has been highly increasing. To meet the high demand production through conventional method was inadequate. By introduction of Surface Miner, we can fulfil the demand of coal in reduced time and resources.

2.1.2 Samaleshwari Mines

SL.NO.	INFORMATION	DATA
01	Mine Capacity	15 MT Coal
02.	Total balance Mineable Coal Reserve	33.18 MT
03.	Coal Extracted till 31.03.2014	133.49 MT
04.	Stripping ratio (Avg.)	2.52 : 1 cum /Te
05.	Gradient	1 in 17 to 1 in 19
06.	Maximum Quarry Depth	120 M
07	Area along floor	98.54 Ha
08	Average seam thickness	23.94 M
09.	Total Manpower	1511
10.	Quality of Coal	87%F & 13% G
11.	Quarry perimeter	6581.93 M
12.	Main Customer	ITPS (OPGC)
13.	Production 2013-14(Coal)	110 Lakh Te.
14.	O.B. Removal 2013-14	135.31 Lakh CuM.

2.2 GENERAL DESCRIPTION OF SURFACE MINERS

2.2.1 Definition

A surface miner also called as continuous surface miner, is the technology in which extraction, crushing and loading of minerals is done in single pass. So, this technology, can be used as a substitute to conventional method of mining which involves drilling and blasting of minerals and rock deposits, if applicable. It also eliminates primary and secondary crushing [].

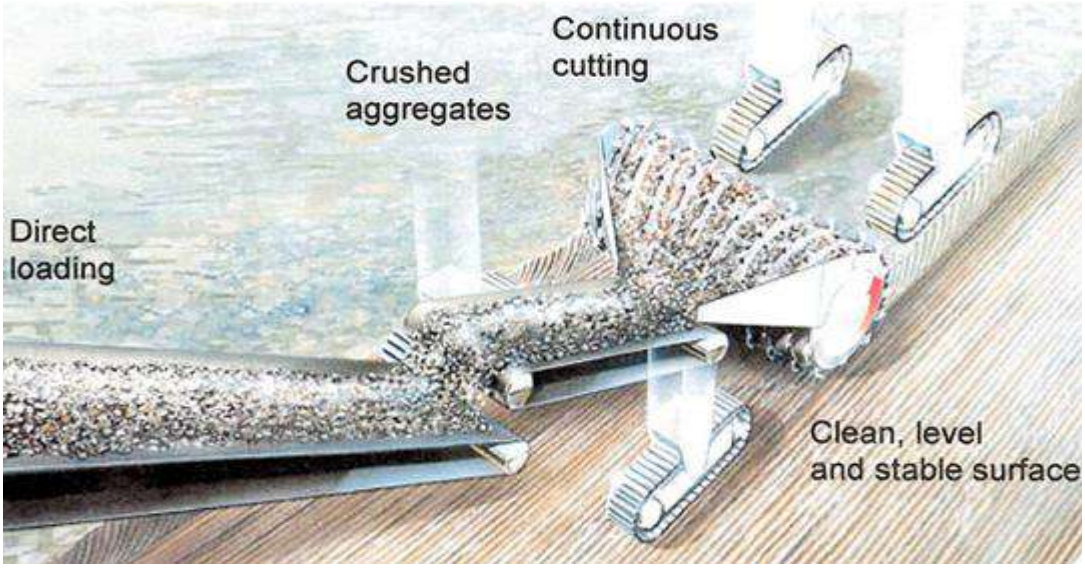

Figure 2.2: Cutting, Crushing and Loading in one go (www.wirtgen.com)

2.2.2 Types of Surface miner

There are basically 3 types of surface miners that are available in market today, they are categorised based on their design. Different types of Surface miners are:

- Machines with middle drum configuration.

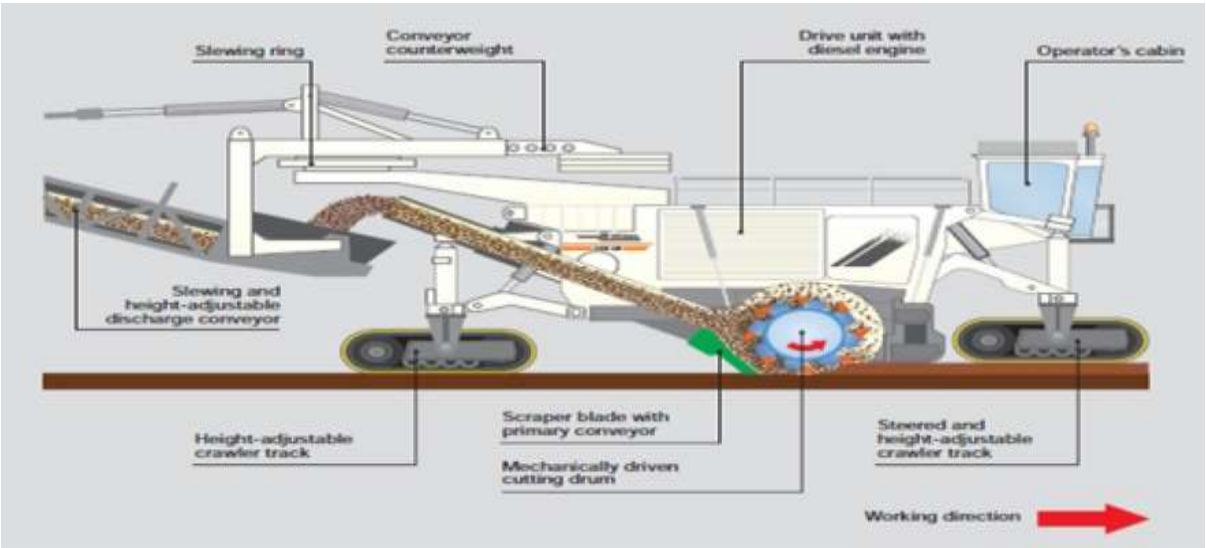

Figure 2.3: Machine with middle drum configuration (www.wirtgen.com)

These are the most commonly available surface miners in the market. Writgen, Bitelli, Huron and L&T machines belong to this group.

- Machines with front boom cutting drum.

Figure 2.4: Machine with front boom cutting drum

Tesmec, Veermer, Voest alpine surface miners belong to this group.

- Machines with front cutting wheel.

Figure 2.5: Machine with front cutting drum (http://www.readbag.com/mine- planning-publications-documents-large-surface-miners)

KSM type machines from Krupp Fordertechnik, TSM type machines from Tenova TAKRAF belong to this group.

2.2.3 Specifications of Surface miners

Details specifications of Different types of surface miners are given in Table 1: Wirtgen (Model no. SM2100, SM 2200, SM 2500, SM 3700, SM 4200), L&T (Model no.KSM304 & KSM 223), Trencor 3000SM, Takraf [11] (Model no. MTS 180, MTS 300, MTS 500, MTS800, MTS1250, MTS2000), Bitelli (Model no.SF202 M), and Vermeer [13] (model no.T855, T955, T1055, T1225). Among these Wirtgen is the world's largest manufacturer of surface miners.

Table 2.1: Specification of different surface miner models

	Parameters	Drum width (m)	Machine power (kW)	Operating weight (ton)	Rated capacity (m^3/h)	Cutting depth (mm)	Maximum cutting speed (m/min)	Operating gradient (1 in x)
Wirtgen GmbH	SM 2100	2.0	448	41	550	250	25	6
	SM2200	2.2	671	49	668	350	84	6
	SM2500	2.5	783	100	845	600	25	7
	SM3500	3.5	895	137	1900	470	25	12
	SM4200	4.2	1194	184	2400	600	20	5
Vermeer	T855	2.5	281	40.8	NA	812	28	NA
	T955	3.4	309	56.7	NA	812	20	NA
	T1055	3.4	317	61.2	NA	812	16	NA
	T1255	3.7	447	99.8	NA	610	12	NA
L & T	KSM223	2.2	597	NA	NA	350	83	8
	KSM304	3.0	895	100	NA	400	20	5
TAKRAF GmbH	MTS180	3.3	500	NA	180	700	NA	NA
	MTS300	4.0	750	NA	300	875	NA	NA
	MTS500	4.9	1650	NA	500	1050	NA	NA
	MTS800	5.6	2000	NA	800	1225	NA	NA
	MTS1250	6.5	2500	NA	1250	1400	NA	NA
	MTS2000	7.4	2500	NA	2000	1575	NA	NA
Bitelli	SF202	2.0	515	43	180	250	NA	NA

2.3 SURFACE MINER APPLICATIONS IN INDIA

In India, Surface miners were first introduced on trial bases at the lime stone mine of Gujarat Ambuja cements in 1994. Finally, in the year 1995 wirtgen introduced surface mining technology in India in Gujarat Ambuja cements limited. In the same year Madras cements also deployed its first Writgen surface miner. Today, more than 16 surface miners are in operation in different limestone quarries of India. When it comes to coal mines, the first break through of surface miner (Wirtgen make – 2100SM) took place in 1999 at Lakhanpur opencast coal mines of Mahanadi Coalfields Limited (MCL), a subsidiary of Coal India Limited (CIL). A total of 47 surface miners (32 Wirtgen, 3 Bitelli, 12 L&T make) of different sizes and capacities have been deployed in different collieries of MCL, Central Coalfields Limited (CCL) and South Eastern Coalfields Limited (SECL) during 2010-2011.

Table 2.2: Surface miner details in Indian coal fields [8].

Coal Company	Project	Size(mm)	Make	Population	Coal production (in Million Tonnes) per Aunnum
CCL	Ashok	3800	Wirtgen	1	6.01
	Piparwar	2200	Wirtgen	5	6.01
SECL	Gevra & Dipka Expansion	3200	L&T	6	22.82 Gevra 11.72 Dipka
		3800	Wirtgen	5	
	Kusmunda	3200	L&T	2	4.71
MCL	Basundara(W) Samaleswari Belpahar Lakhanpur Hingula Ananta Bhubaneswari Bharatpur & Lingraj	3800	Wirtgen	10	51.47
		3000	L&T	4	
		2200	Wirtgen	3	
		2100	Wirtgen	8	
		2200	Bitelli	2	
			Bitelli	1	
Total				47	

2.4 OPERATING MODES

The surface miner can be operated in different ways based on the onsite requirements. The operating methods of surface miner are mainly categorised into three categories depending on the machine travel mode. They are:

a) Empty travel back method :

In this method, the surface miner cuts the material from one end of the pit then it moves back to the starting end. During the backward movement there will be no cutting of material, i.e., it travels back

empty. After coming back to the starting point, the machine is adjusted for a new cut in adjacent strip as shown in the Figure 6.

This method is generally adopted in the mines having a less pit length, where the turning time is more than the empty travel back time. It is also applicable in case of bad pit-end condition where the machine is not able to turn there or when the pit width is not sufficient to allow the turning of machine at the end of a cut.

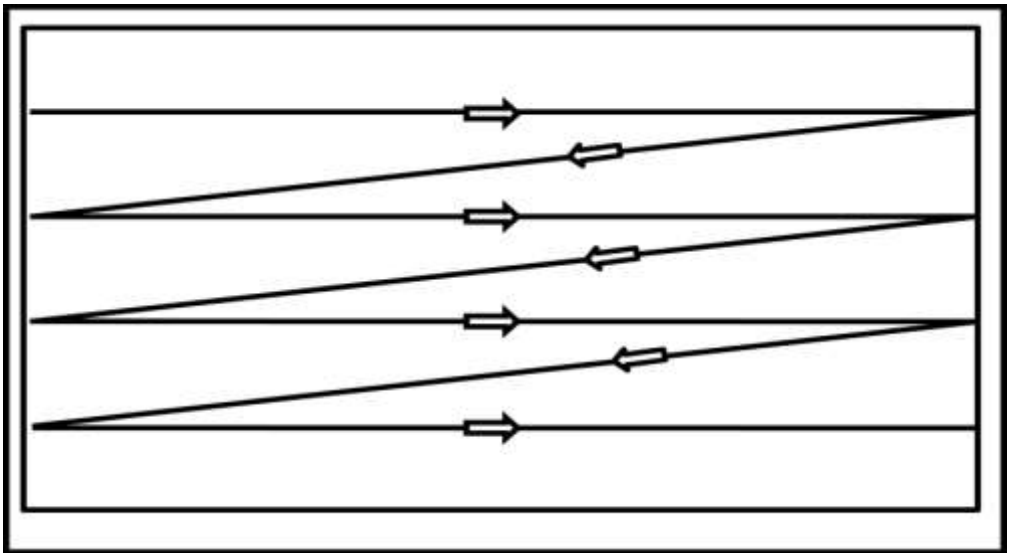

Figure 2.6: Empty travel back method [11]

b) Turn back method:

In this method, the surface miner cuts from one end of the area and after completing the cut, the cutting drum is raised and the machine turns back, and set itself at the adjacent strip as shown in Figure 7.

This method is generally adopted in the mines having a field length of more than 200 m, so that the time consumption in turning is lesser than empty travel back time. This method is widely used in limestone mines as it gives more production.

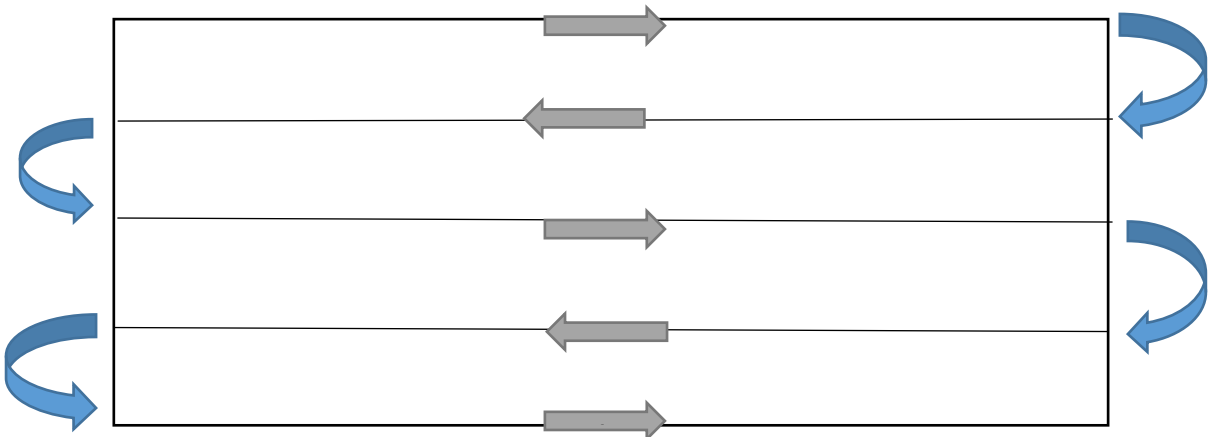

Figure 2.7: Turn back method [11]

c) Continuous mining method

In this method, the Surface miner operates on an even field and continuously cuts the material. The machine moves with cutting the material and near the pit end, it turns with a gentle angle without raising the cutting drum, so that there is no discontinuity in cutting operation. The cut area gets an oval shape, as shown in the Figure 8.

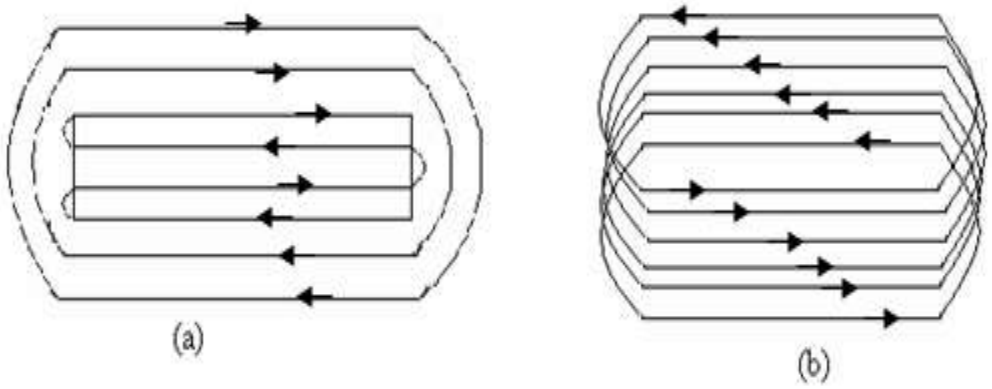

Figure 2.8: Continuous mining method [10]

After it completes an elliptical movement, next adjacent cut is taken. This process continues till the elliptical turning gets a limiting angle. Then machine goes for turn back method.

2.5 OTHER OPERATIONAL FEATURES

a) Block operation with ramp cutting

While cutting the block down to its planned level, the surface miner cuts its own ramp. After completing the cut of the first block, the next block can be started adjacent to the first one. Since turning on narrow benches is difficult and time consuming, two alternative operations can be recommended:

- Turning the machine on an appropriate area outside the ramp.
- Reverse the machine after finishing one cut and then reposition the surface miner at the adjacent cut.

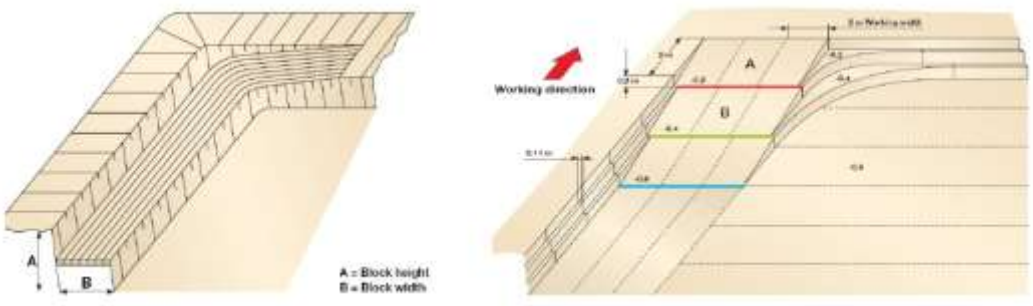

Figure 2.9: Ramp cutting using surface miner

As a rule of thumb, the turning radius is 12 multiply cutting width (when cutting harder rock, the cutting depth has to be reduced) (Dey, 1999; Dutta, 2012).

b) Cutting of Highwalls

The surface miner can produce very stable highwalls as compared to conventional methods. Generally, Surface Miner can achieve a slope angle of 60° in normal operation. Highwalls formed by surface miners are stable, precise and clean.

Figure 2.**10**: **Highwall (www.wirtgen.com)**

c) Working Length

The productivity of a surface miner depends on the length of working area available. Longer cuts will increase the productivity, because only a smaller amount of time is spent in manoeuvring from one cut to the next. The forward speed depends on the following factors:

- cutting depth
- material hardness and structure
- type of machine and installed engine power

In standard applications, the appropriate minimum cutting field length should be in the range of (Dey, 1999; Dutta, 2012):

- 100 m (hard material, low forward speed)
- 300 m (softer material, high forward speed)

2.6 TYPES OF LOADING

a) Conveyor loading

In this type of loading, the excavated material is directly loaded into the trucks or dumpers. This arrangement consists of a scrapper plate which helps in collecting the excavated material, primary and discharge conveyors which helps in transporting the excavated material and also a discharge boom that can slew in both directions and also the height of the boom can be adjusted according to the requirement.

Figure 2.11: Conveyor loading system (www.wirtgen.com)

This arrangement intrinsically involves loss of time which occurs due to the replacement of a filled up dumper or truck with an empty one. So, the efficiency of this arrangement mainly depends on the number of dumpers working, availability of space for the trucks or dumpers to have good manoeuvrability, and also the positioning of the empty dumpers.

b) Windrowing

In this method, the material excavated is heaped behind the machine in a row. Later, this material is loaded into dumpers by using different loading equipment like front end loader and scraper.

Figure 2.12: Windrowing system (www.wirtgen.com)

The overall efficiency is more for windrowing method because it is independent form truck loading. In addition, there is also no operating cost of the conveyor. Thus, it is the most productive mode of a surface miner.

c) Side casting

In this method, the discharge belt dumps the material on the side of the cut being made by the surface miner, shown in Figure 14. This dumped material is later loaded to dumpers/trucks with the help of loaders and taken away. In this method, the machine is free from disturbances caused due to loading

Figure 2.13: Side casting system (www.wirtgen.com)

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Table 2.3: Comparison of different loading methods

Loading method	Advantages	Disadvantages
Direct loading	• No re-handling of material required.	• Larger working area required for truck manoeuvring. • Production affected by truck exchange time. • Belt wear.
Side casting	• Blending of material in the mine. Stockpile of material in the mine. • No waiting for trucks, independent operation.	• Restricted to 3-5 cuts wide on each side of the mine stockpile. • Belt wear. • Material has to be re-handled. • Material prone to absorb water when lying on the ground.
Windrowing	• No waiting for trucks. • No belt wear/higher availability. • Higher production rates than conveyor loading. • Coarser material. • Better selectivity in steep inclined seams.	• Large working area required. • Material has to be handled either by loader or scraper. • Material prone to absorb water when lying on the ground.

TABLE 2.4: Comparison of Surface Miner and Conventional System of Mining

Mining by surface miner	Conventional system of mining
No requirement of drilling, blasting and crushing	Requirement of drilling, blasting and crushing.
Mining is possible in close proximity of village, road and other permanent structure.	Mining is not possible due to restriction in blasting
No chance of spontaneous heating and fire.	Blasting produces crack in the coal bench which leads to spontaneous heating and fire.

Stability of bench and high wall is comparatively much better.	Stability of benches and high wall is comparatively poor due to induced stress caused by blasting.
It is an environmentally friendly method of mining	Drilling, blasting and crushing produces adverse effect on environment.
Selective mining is possible as a result quality of mined out coal is better.	Selective mining is not possible.
Thin seam mining is possible as a result non-workable seam becomes workable.	Thin seam mining is not possible.
Less capital investment and infrastructure is required.	High capital investment and infrastructure is required.

2.7 OVERALL EQUIPMENT EFFECTIVENESS

Overall equipment effectiveness (OEE) is a simple tool developed by Seiichi Nakajima in the 1960's to measure the performance against the capability of the equipment. It takes into consideration the most common and important sources of productivity loss, which are called six big losses. These losses are quantified as availability, performance and quality. Most of the mining equipment involved mainly for production are either cutting/excavating or loading/transporting. So, for calculating the OEE of the mining equipment we have replaced here the quality rate with utilisation rate. So for mining machinery, then OEE will be

$$OEE = Availability \times Performance\ rate \times Utilisation\ rate$$

where

$$\text{Availability} = \frac{(\text{Total Available time}) - (\text{Total Downtime})}{\text{Total available or planned time}}$$

Total Available time refers to the total available shift/ planned time for production and downtime refers to any events that stop planned production for an appreciable length of time. It includes equipment failures, material shortages, Maintenance of equipment and changeover time.

$$\text{Performance rate} = \frac{\text{Actual output from a machine (when meet the required quality standard)}}{\text{Rated output (during the time machine is operating)}}$$

Performance rate is used for calculation of losses that arise due to the operation of the mining machine at reduced performance levels. The reason may be because of reduced machine speed or delay in

cycle time and losses in operational efficiency resulting from the loss of optimum machine performance e.g. shovel bucket not taking full load, taking more loading time etc.

$$\text{Utilisation rate} = \frac{\text{Use or Worked time}}{\text{Total planned time}}$$

The above mentioned three efficiency measures along with six big losses and performance indicator are given in Table 2.5. The next step after the estimation of OEE is to compare it with the benchmark values. As a benchmark, if the OEE score is

- < 65% Unacceptable, require help now.
- 65-75% Passable only if quarterly trends are improving.
- >75% pretty good, but should not stand still. Drive to world class (80%).

Measurement of OEE is required for proper management the equipment. The advantage of using OEE as a measure is that it clearly identifies causes of losses in machine effectiveness, and allows the continuous monitoring of the most critical factors which influence machine performance. A little improvement on the OEE represents a significant contribution to mine productivity, profitability and capabilities.

Table 2.5: Six big losses

Six Big Loss Category	OEE Loss Category	OEE Factor
Unplanned shutdown losses	Downtime Losses	Availability (A)
Breakdown losses		
Setup and Adjustment		
Idling and Minor Stoppages	Speed Losses	Performance rate (P)
Reduced Speed		
Reduced Yield at start or process transition	Use Losses	Utilisation rate(U)
Idle Time		

CHAPTER 3

DATA COLLECTION AND ANALYSIS

3 DATA COLLECTION AND ANALYSIS

3.1 METHODOLOGY

The methodology adopted in this project is as follows:

- In order to achieve the stated objectives, field survey and data collection was carried out in Lakhanpur opencast coal project and Samaleswari opencast coal project of Mahanadi Coalfields Limited.
- A record of working hours (WH), idle hour (IH), Maintenance hour (MH), Break down hour (BH) and Achieved production details on monthly and daily basis were collected from above mentioned mines.

a) Calculation of availability, utilization rate and performance rate by:

$$A = \frac{SSH - (BH + MH)}{SSH}$$

$$U = \frac{SSH - (BH + MH + ID)}{SSH}$$

$$Pr = \frac{Achieved\ production(Tons)}{Target\ production(Tons)}$$

Where, A is Availability, U is Utilisation rate, Pr is Performance rate, SSH is scheduled shift hour, MH is maintenance hour, BH is breakdown hour and ID is idle hour.

b) Calculation of OEE**:**

$$OEE = Availability(A) \times Performance\ rate(Pr) \times Utilisation\ rate(U)$$

For calculating OEE, A, U and Pr have been given the equal weights but when it comes to actual practice in the field this may not be case. So we assume weights as follows: availability: 0.2, utilisation: 0.7 and performance rate: 0.1 for calculating on daily basis and for calculating on monthly basis we assume weights as follows: availability: 0.3, utilisation: 0.5 and performance rate: 0.2. These weights have been taken after considering the relative importance of the above using Analytic Hierarchy process (AHP).

So using the above we have

$$OEE(Daily\ basis) = (A^{0.2}) \times (Pr^{0.1}) \times (U^{0.7})$$

$$OEE(Monthly\ basis) = (A^{0.3}) \times (Pr^{0.2}) \times (U^{0.5})$$

c) Analysis of availability, utilization rate, performance rate, OEE, Idle hours, breakdown hours, achieved production is done with the help of graphs.

3.2 DAILY PERFORMANCE OF SURFACE MINERS IN LAKHANPUR OCP

Table 3.1: Performance of Surface miner (Rungta 468) at Lakhanpur OCP

Date	S/T	W/H	M/H	I/H	B/D	Availability	Utilisation	Target Production(T)	Achieved Production(T)	Performance rate	Theoretical OEE	Estimated OEE
17.12.13	24	7	5	12	0	79.17	29.17	15000	4906	32.71	0.0755	0.36
18.12.13	24	15	5	4	0	79.17	62.5	15000	12264	81.76	0.4045	0.67
19.12.13	24	15	4	5	0	83.33	62.5	15000	14260	95.07	0.4951	0.69
20.12.13	24	17	4	3	0	83.33	70.83	15000	14282	95.21	0.5620	0.75
21.12.13	24	8	4	4	8	50	33.33	15000	8065	53.77	0.0896	0.38
22.12.13	24	12	3.5	6	2.5	75	50	15000	10601	7.67	0.2650	0.56
23.12.13	24	3	0	0	21	12.50	12.5	15000	3001	20.01	0.0031	0.13
24.12.13	24	6.5	2.5	3	12	39.58	27.08	15000	5070	33.80	0.0362	0.30
25.12.13	24	13	5	6	0	79.17	54.17	15000	11588	77.25	0.3313	0.61
26.12.13	24	7	4	5	8	50	29.17	15000	4901	32.67	0.0476	0.33
27.12.13	24	12.5	4.5	7	0	81.25	52.08	15000	9705	64.7	0.2738	0.58
28.12.13	24	12	2	1.5	8.5	56.25	50	15000	8796	58.64	0.1649	0.52
29.12.13	24	14.5	5	4.5	0	79.17	60.42	15000	12270	811.8	0.3912	0.66
30.12.13	24	14	5	5	0	79.17	58.33	15000	11018	73.45	0.3392	0.63
31.12.13	24	11.5	6.5	6	0	72.92	47.92	15000	8799	58.66	0.2050	0.53
01.01.14	24	14	4	6	0	83.33	58.33	15000	11330	75.53	0.3672	0.64
02.01.14	24	13	6	5	0	75	54.17	15000	11779	78.53	0.3190	0.60
03.01.14	24	14	6	4	0	75	58.33	15000	14508	96.72	0.4232	0.65
04.01.14	24	12.5	5.5	6	0	77.08	52.08	15000	13485	89.90	0.3609	0.59
05.01.14	24	11	4	3	6	58.33	45.83	15000	10437	69.58	0.1860	0.50
06.01.14	24	10.5	3.5	4	6	60.42	43.75	15000	9917	66.11	0.1748	0.49
07.01.14	24	13.5	3.5	4	3	72.92	56.25	15000	13930	92.87	0.3809	0.62
08.01.14	24	13.5	4	3	3.5	68.75	56.25	15000	13423	89.49	0.3461	0.61
09.01.14	24	9	0	1	14	41.67	37.5	15000	9016	60.11	0.0939	0.40
Total	576	279	96.5	108	92.5	67.19	48.44	360000	247351	68.71	0.2236	0.54

S/T= Scheduled Time, W/H= Working Hour, M/H= Maintenance Hour, I/H= Idle Hour, B/H= Breakdown Hour

Table 3.2: Performance of Surface miner (Rungta 625) at Lakhanpur OCP

Date	S/T	W/H	M/H	I/H	B/H	Availability	Utilisation	Target Production(T)	Achieved production(T)	Performance rate	Theoretical OEE	Estimated OEE
17.12.13	24	16	5	3	0	79.17	66.67	15000	11211	74.74	0.3945	0.70
18.12.13	24	10.5	2.5	4	7	60.42	43.75	15000	8584	57.23	0.1513	0.48
19.12.13	24	10	7	7	0	70.83	41.67	15000	9508	63.39	0.1871	0.48
20.12.13	24	14	2	3	5	70.83	58.33	15000	11762	78.41	0.3240	0.62
21.12.13	24	14.5	5.5	4	0	77.08	60.42	15000	14616	97.44	0.4538	0.67
22.12.13	24	15	3	6	0	87.50	62.5	15000	13251	88.34	0.4831	0.69
23.12.13	24	15	5	4	0	79.17	62.5	15000	14661	97.74	0.4836	0.69
24.12.13	24	17	3	4	0	87.50	70.83	15000	13259	88.39	0.5479	0.76
25.12.13	24	13	5	6	0	79.17	54.17	15000	11588	77.25	0.3313	0.61
26.12.13	24	17.5	4	2.5	0	83.33	72.92	15000	12251	81.67	0.4963	0.76
27.12.13	24	11	4.5	3.5	5	60.42	45.83	15000	8584	57.23	0.1585	0.50
28.12.13	24	14	6	4	0	75	58.33	15000	10261	68.41	0.2993	0.62
29.12.13	24	13.5	6	4.5	0	75	56.25	15000	11424	76.16	0.3213	0.61
30.12.13	24	14.5	5	4.5	0	79.17	60.41	15000	11413	76.09	0.3639	0.65
31.12.13	24	14	4	6	0	83.33	58.33	15000	10711	71.41	0.3471	0.64
01.01.14	24	4.5	1	1	17.5	22.92	18.75	15000	3642	24.28	0.0104	0.20
02.01.14	24	0	0	0	24	0	0	15000	0	0	0	0
03.01.14	24	0	0	0	24	0	0	15000	0	0	0	0
04.01.14	24	0	0	0	24	0	0	15000	0	0	0	0
05.01.14	24	0	0	0	24	0	0	15000	0	0	0	0
06.01.14	24	0	0	0	24	0	0	15000	0	0	0	0
07.01.14	24	0	0	0	24	0	0	15000	0	0	0	0
08.01.14	24	0	0	0	24	0	0	15000	0	0	0	0
09.01.14	24	0	0	0	24	0	0	15000	0	0	0	0
OVERALL	576	214	68.5	67	226.5	48.78	37.15	360000	176726	49.09	0.089	0.40

S/T= Scheduled Time, W/H= Working Hour, M/H= Maintenance Hour, I/H= Idle Hour, B/H= Breakdown Hour

Table 3.3: Performance of Surface miner (Rungta 634) at Lakhanpur OCP

Date	S/T	W/H	M/H	I/H	B/H	Availability	Utilisation	Target Production(T)	Achieved production(T)	Performance rate	Theoretical OEE	Estimated OEE
17.12.13	24	16	4	4	0	83.33	66.67	15000	11211	74.74	0.4152	0.71
18.12.13	24	16	5	3	0	79.17	66.67	15000	13081	87.21	0.4603	0.71
19.12.13	24	15	4	5	0	83.33	62.50	15000	14261	95.07	0.4952	0.69
20.12.13	24	13	4	4	3	70.83	54.17	15000	10922	72.81	0.2794	0.59
21.12.13	24	14.5	5	4.5	0	79.17	60.42	15000	14616	97.44	0.4661	0.67
22.12.13	24	15	3	6	0	87.50	62.50	15000	13251	88.34	0.4831	0.69
23.12.13	24	12.5	5.5	6	0	77.08	52.08	15000	12217	81.45	0.3270	0.59
24.12.13	24	15.5	5.5	3	0	77.08	64.58	15000	12089	80.59	0.4012	0.68
25.12.13	24	11.5	6.5	6	0	72.92	47.92	15000	10251	68.34	0.2388	0.54
26.12.13	24	17	4	3	0	83.33	70.83	15000	11901	79.34	0.4683	0.74
27.12.13	24	13	5	6	0	79.17	54.17	15000	10093	67.29	0.2885	0.60
28.12.13	24	15	5	4	0	79.17	62.50	15000	10994	73.29	0.3626	0.67
29.12.13	24	5	1	2	16	29.17	20.83	15000	4231	28.21	0.0171	0.23
30.12.13	24	9	3	4	8	54.17	37.50	15000	7084	47.23	0.0959	0.41
31.12.13	24	15	6	3	0	75	62.50	15000	11476	76.51	0.3586	0.66
01.01.14	24	14	4	6	0	83.33	58.33	15000	11330	75.53	0.3672	0.64
02.01.14	24	13	6	5	0	75	54.17	15000	13591	90.61	0.3681	0.61
03.01.14	24	13	6	5	0	75	54.17	15000	13471	89.81	0.3648	0.61
04.01.14	24	14	5	5	0	79.17	58.33	15000	15103	100.69	0.4650	0.65
05.01.14	24	15.5	5.5	3	0	77.08	64.58	15000	16869	112.46	0.5599	0.71
06.01.14	24	16	4	4	0	83.33	66.67	15000	15111	100.74	0.5597	0.73
07.01.14	24	12.5	5	6.5	0	79.17	52.08	15000	12899	85.99	0.3546	0.60
08.01.14	24	15.5	5.5	3	0	77.08	64.58	15000	15199	101.33	0.5044	0.70
09.01.14	24	17.5	4	2.5	0	83.33	72.92	15000	17531	116.87	0.7102	0.79
OVERALL	576	334	111.5	103.5	27	75.95	57.99	360000	298782	83	0.3655	0.63

S/T= Scheduled Time, W/H= Working Hour, M/H= Maintenance Hour, I/H= Idle Hour, B/H= Breakdown Hour

Table 3.4: Performance of Surface miner (Rungta 336) at Lakhanpur OCP

Date	S/T	W/H	M/H	I/H	B/H	Availability	Utilisation	Target Production(T)	Achieved production(T)	Performance rate	Theoretical OEE	Estimated OEE
17.12.13	24	12	3	4	5	66.67	50	15000	8408	56.05	0.1868	0.5357
18.12.13	24	0	0	0	24	0	0	15000	0	0	0	0
19.12.13	24	0	0	0	24	0	0	15000	0	0	0	0
20.12.13	24	0	0	0	24	0	0	15000	0	0	0	0
21.12.13	24	0	0	0	24	0	0	15000	0	0	0	0
22.12.13	24	3	0	0	21	12.5	12.5	15000	2650	17.67	0.0028	0.13
23.12.13	24	13	5	6	0	79.17	54.17	15000	12637	84.25	0.3613	0.61
24.12.13	24	12.5	6	5.5	0	75	52.08	15000	9750	65	0.2539	0.57
25.12.13	24	7.5	6.5	6	4	56.25	31.25	15000	6686	44.57	0.0784	0.36
26.12.13	24	12.5	2	1.5	8	58.33	52.08	15000	8750	58.33	0.1772	0.54
27.12.13	24	12.5	5.5	6	0	77.08	52.08	15000	9705	64.70	0.2598	0.58
28.12.13	24	11	5	2	6	54.17	45.83	15000	8063	53.75	0.1335	0.48
29.12.13	24	10.5	5.5	8	0	77.08	43.75	15000	8885	59.23	0.1998	0.51
30.12.13	24	12.5	3.5	8	0	85.42	52.08	15000	9839	65.59	0.2918	0.59
31.12.13	24	10.5	6	7.5	0	75	43.75	15000	8033	53.55	0.1757	0.5
01.01.14	24	10.5	5.5	6	2	68.75	43.75	15000	8497	56.65	0.1704	0.49
02.01.14	24	13	5	6	0	79.17	54.17	15000	11778	78.52	0.3367	0.61
03.01.14	24	13.5	6	4.5	0	75	56.25	15000	13989	93.26	0.3934	0.63
04.01.14	24	13.5	5.5	5	0	77.08	56.25	15000	14564	97.09	0.4210	0.63
05.01.14	24	14	6	4	0	75	58.33	15000	14426	96.17	0.4208	0.65
06.01.14	24	18.5	3	2.5	0	87.5	77.08	15000	17472	116.48	0.7856	0.82
07.01.14	24	16	5	3	0	79.17	66.67	15000	16510	110.07	0.5809	0.73
08.01.14	24	15	6	3	0	75	62.5	15000	14805	98.70	0.4627	0.68
09.01.14	24	13	2	1	8	58.33	54.17	15000	13023	86.82	0.2743	0.58
OVERALL	576	244.5	92	89.5	150	57.99	42.45	360000	218470	60.69	0.1494	0.47

S/T= Scheduled Time, W/H= Working Hour, M/H= Maintenance Hour, I/H= Idle Hour, B/H= Breakdown Hour

Table 3.5: Performance of Surface miner (L&T-303(15)) at Lakhanpur OCP

Date	S/T	W/H	M/H	I/H	B/H	Availability	Utilisation	Target Production(T)	Achieved Production(T)	Performance rate	Theoretical OEE	Estimated OEE
17.12.13	24	13.8	6	4.2	0	75	57.5	7500	5173	68.97	0.2974	0.62
18.12.13	24	6.25	6	11.75	0	75	26.04	7500	4322	57.63	0.1126	0.35
19.12.13	24	11.25	6.75	6	0	71.88	46.88	7500	9322	124.29	0.4188	0.56
20.12.13	24	14	3.5	6	0.5	83.33	58.33	7500	8014	106.85	0.5194	0.67
21.12.13	24	8	8	8	0	66.67	33.33	7500	5078	67.71	0.1505	0.41
22.12.13	24	0	0	0	24	0	0	7500	1755	23.40	0	0
23.12.13	24	11	5	8	0	79.17	45.83	7500	2421	32.28	0.1171	0.49
24.12.13	24	8.5	6	5.5	4	58.33	35.42	7500	3971	52.95	0.1094	0.41
25.12.13	24	6.5	5.5	5	7	47.92	27.08	7500	6067	80.89	0.1050	0.34
26.12.13	24	11	6	7	0	75	45.83	7500	4553	60.71	0.2087	0.52
27.12.13	24	7	3	2	12	37.5	29.17	7500	4447	59.29	0.0649	0.33
28.12.13	24	13.5	5	5.5	0	79.17	56.25	7500	4150	55.33	0.2464	0.60
29.12.13	24	11.8	5.2	7	0	79.33	49.17	7500	5040	67.20	0.2588	0.56
30.12.13	24	8.3	6	9.7	0	75	34.58	7500	4922	65.63	0.1702	0.43
31.12.13	24	9.8	6	8.2	0	75	40.83	7500	5415	72.20	0.2211	0.49
01.01.14	24	8.5	5.5	10	0	77.08	35.42	7500	5028	67.04	0.1830	0.44
02.01.14	24	11.5	5.5	7	0	77.08	47.92	7500	5701	76.01	0.2808	0.55
03.01.14	24	8.8	5.7	9.5	0	76.25	36.67	7500	3077	41.03	0.1147	0.43
04.01.14	24	5.8	5.5	12.7	0	77.08	24.17	7500	1395	18.60	0.0346	0.30
05.01.14	24	5.5	6	12.5	0	75	22.92	7500	885	11.80	0.0203	0.27
06.01.14	24	3.8	6	14.2	0	75	15.83	7500	1155	15.40	0.0183	0.22
07.01.14	24	12	6	6	0	75	50	7500	885	11.80	0.0443	0.47
08.01.14	24	14.5	6	3.5	0	75	60.42	7500	1515	20.20	0.0915	0.57
09.01.14	24	13.5	5	5.5	0	79.17	56.25	7500	8260	110.13	0.4904	0.64
OVERALL	576	224.6	129.15	174.75	47.5	69.33	38.99	180000	102551	56.97	0.1540	0.45

S/T= Scheduled Time, W/H= Working Hour, M/H= Maintenance Hour, I/H= Idle Hour, B/H= Breakdown Hour

Table 3.6: Performance of Surface miner (L&T-303(21)) at Lakhanpur OCP

Date	S/T	W/H	M/H	I/H	B/H	Availability	Utilisation	Target Production(T)	Achieved Production(T)	Performance rate	Theoretical OEE	Estimated OEE
17.12.13	24	13.3	6	4.7	0	75	55.42	7500	6959	92.79	0.385	0.62
18.12.13	24	16.5	4	3.5	0	83.33	68.75	7500	11924	158.99	0.9109	0.78
19.12.13	24	13.1	5.9	5	0	7542	54.58	7500	6033	80.44	0.3311	0.61
20.12.13	24	9	5	10	0	79.17	37.50	7500	4689	62.52	0.1856	0.46
21.12.13	24	8.5	8	7.5	0	66.67	35.42	7500	2904	38.72	0.0914	0.41
22.12.13	24	7	0	17	0	100	29.17	7500	2415	32.20	0.0939	0.38
23.12.13	24	9	5	10	0	79.17	37.50	7500	3777	50.36	0.1495	0.45
24.12.13	24	9	6	9	0	75	37.50	7500	4438	59.17	0.1664	0.45
25.12.13	24	10.5	5.5	8	0	77.08	43.75	7500	4189	55.85	0.1884	0.50
26.12.13	24	7.8	6	10.2	0	75	32.50	7500	6858	91.44	0.2229	0.43
27.12.13	24	12	5	7	0	79.17	50	7500	7931	105.75	0.4186	0.60
28.12.13	24	10.3	5	8.7	0	79.17	42.92	7500	7534	100.45	0.3413	0.53
29.12.13	24	7.3	6	10.7	0	75	30.42	7500	6863	91.51	0.2087	0.41
30.12.13	24	9.5	6	8.5	0	75	39.58	7500	5667	75.56	0.2243	0.48
31.12.13	24	11.5	6	6.5	0	75	47.92	7500	6095.78	81.28	0.2921	0.55
01.01.14	24	8	5.5	7.5	3	64.58	33.33	7500	4733	63.11	0.1359	0.41
02.01.14	24	13	5.5	5.5	0	77.08	54.17	7500	6444	85.92	0.3587	0.61
03.01.14	24	16	5	3	0	79.17	66.67	7500	5626	75.01	0.3959	0.70
04.01.14	24	18	4	2	0	83.33	75	7500	11236	149.81	0.9363	0.82
05.01.14	24	13.5	6	4.5	0	75	56.25	7500	9670	128.93	0.5439	0.65
06.01.14	24	17	4	3	0	83.33	70.83	7500	10820	144.27	0.8516	0.79
07.01.14	24	16	4	4	0	83.33	66.67	7500	11602	154.69	0.8594	0.76
08.01.14	24	11.5	6	6.5	0	75	47.92	7500	12475	166.33	0.5978	0.60
09.01.14	24	11	5	8	0	79.17	45.83	7500	5643	75.24	0.2730	0.54
OVERALL	576	278.3	124.4	170.3	3	77.88	48.32	180000	166525.78	92.51	0.3481	0.57

S/T= Scheduled Time, W/H= Working Hour, M/H= Maintenance Hour, I/H= Idle Hour, B/H= Breakdown Hour

Table 3.7: Performance of Surface miner Nagarjuna (644) at Lakhanpur OCP

Date	S/T	W/H	M/H	I/H	B/H	Availability	Utilisation	Target Production(T)	Achieved Production(T)	Performance rate	Theoretical OEE	Estimated OEE
17.12.13	24	9	7	8	0	70.83	37.5	10000	7635	76.35	0.2028	0.46
18.12.13	24	10	8	6	0	66.67	41.67	10000	8038	80.38	0.2233	0.49
19.12.13	24	12.5	5.5	6	0	77.08	52.08	10000	7690	76.90	0.3087	0.59
20.12.13	24	10	5	9	0	79.17	41.67	10000	6674	66.74	0.2201	0.5
21.12.13	24	10.5	6	7.5	0	75	43.75	10000	6857	68.57	0.2250	0.51
22.12.13	24	10	6	8	0	75	41.67	10000	5368	53.68	0.1678	0.48
23.12.13	24	11	5	8	0	79.17	45.83	10000	7552	75.52	0.2740	0.54
24.12.13	24	11.5	6.5	6	0	72.92	47.92	10000	6963	69.63	0.2433	0.54
25.12.13	24	12	5.5	6.5	0	77.08	50	10000	8209	82.09	0.3164	0.57
26.12.13	24	6	8	10	0	66.67	25	10000	8033	80.33	0.1339	0.34
27.12.13	24	12	5	7	0	79.17	50	10000	7616	76.16	0.3015	0.57
28.12.13	24	11	5	8	0	77.92	45.83	10000	7966	79.66	0.2845	0.54
29.12.13	24	11.5	5	7.5	0	79.17	47.92	10000	8436	84.36	0.32	0.56
30.12.13	24	10.5	5	8.5	0	79.17	43.75	10000	9170	91.70	0.3176	0.53
31.12.13	24	10.5	7	6.5	0	70.83	43.75	10000	7424.22	74.24	0.2301	0.51
01.01.14	24	10.5	5.5	5	3	64.58	43.75	10000	7166	71.66	0.2025	0.50
02.01.14	24	11	5.5	7.5	0	77.08	45.83	10000	7944	79.44	0.2807	0.54
03.01.14	24	10	8	6	0	66.67	41.67	10000	8050	80.50	0.2236	0.49
04.01.14	24	12.5	5	6	0	77.08	52.08	10000	8212	82.12	0.3297	0.59
05.01.14	24	16	3.5	4.5	0	85.42	66.67	10000	9196	91.96	0.5237	0.72
06.01.14	24	11	7	6	0	70.83	45.83	10000	9090	90.90	0.2951	0.54
07.01.14	24	11.5	7	5.5	0	70.83	47.92	10000	8709	87.09	0.2956	0.55
08.01.14	24	12.5	5	6.5	0	79.17	52.08	10000	8028	80.28	0.3310	0.60
09.01.14	24	12.5	3.5	8	0	85.42	52.08	10000	7950	79.50	0.3537	0.60
OVERALL	576	265.5	139.5	168	3	75.26	46.09	240000	187976.22	78.32	0.2717	0.5361

S/T= Scheduled Time, W/H= Working Hour, M/H= Maintenance Hour, I/H= Idle Hour, B/H= Breakdown Hou

3.2.1 Graphs on daily performance assessment of Surface miners (a) SM-468(RUNGTA), (b) SM 625(RUNGTA) (c) SM-634(RUNGTA), (d) SM-336(RUNGTA), (e) SM-L&T-303(015), (f) SM-L&T-303(021), (g) SM-644(Nagarjuna) at Lakhanpur OCP (from 17th Dec 2013 to 9th Jan 2014) have been presented in Figs.

1) Availability Graphs

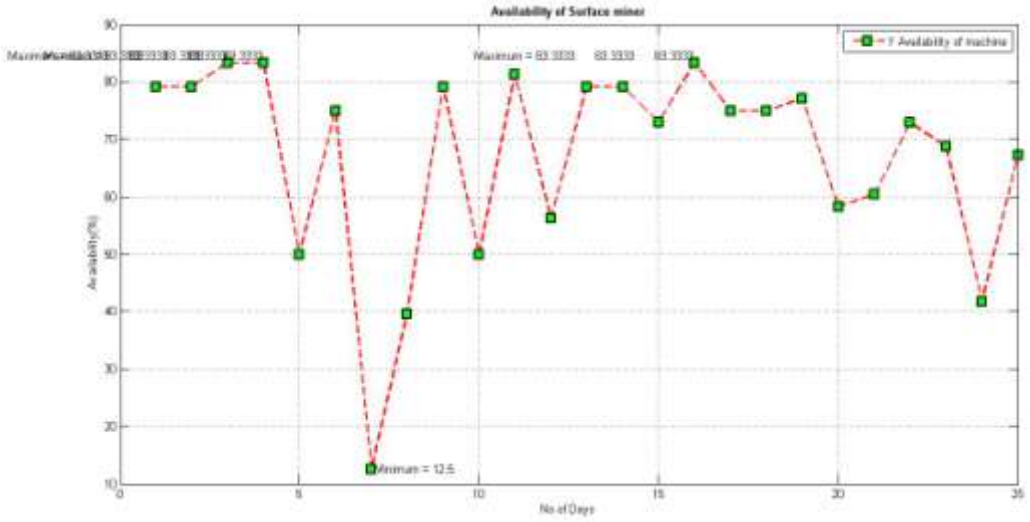

Figure 3.1 (a) Availability of SM-468(RUNGTA)

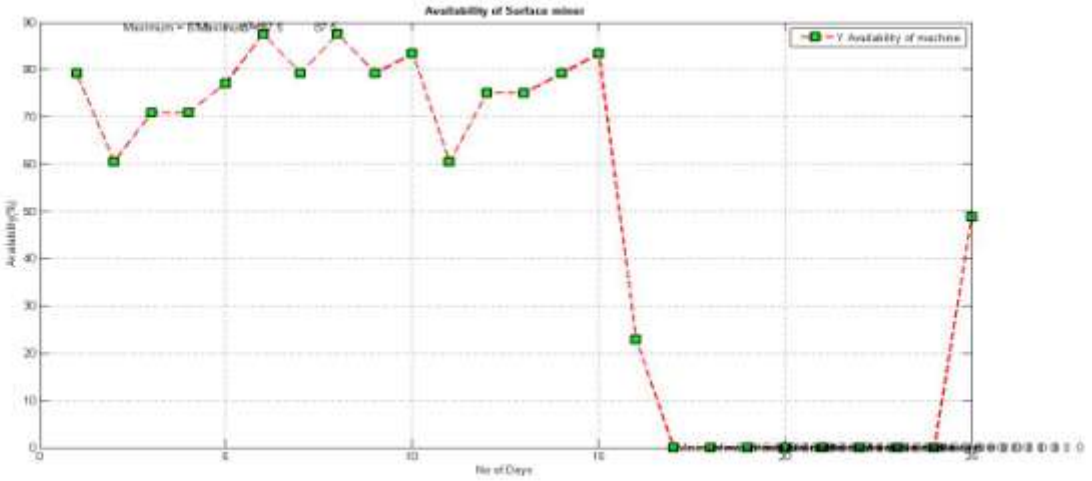

Figure 3.1 (b) Availability of SM-625(RUNGTA)

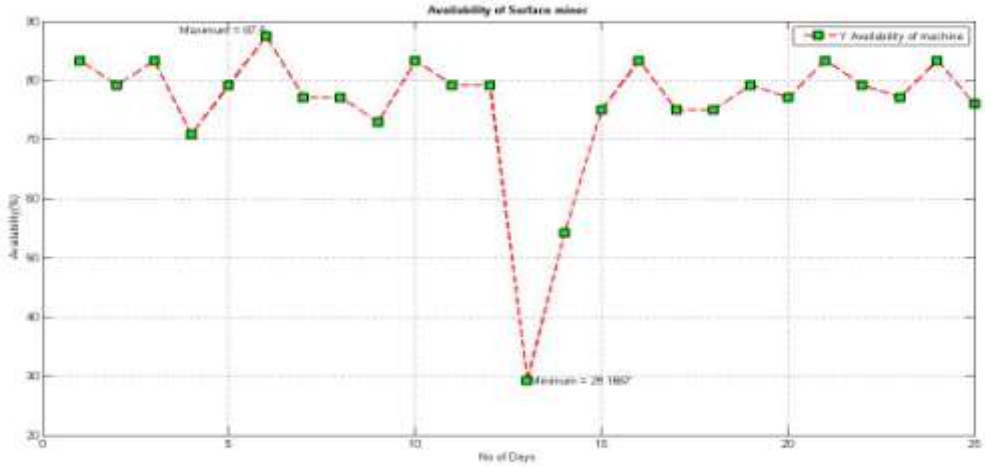

Figure 3.1 (c) Availability of SM-634(RUNGTA)

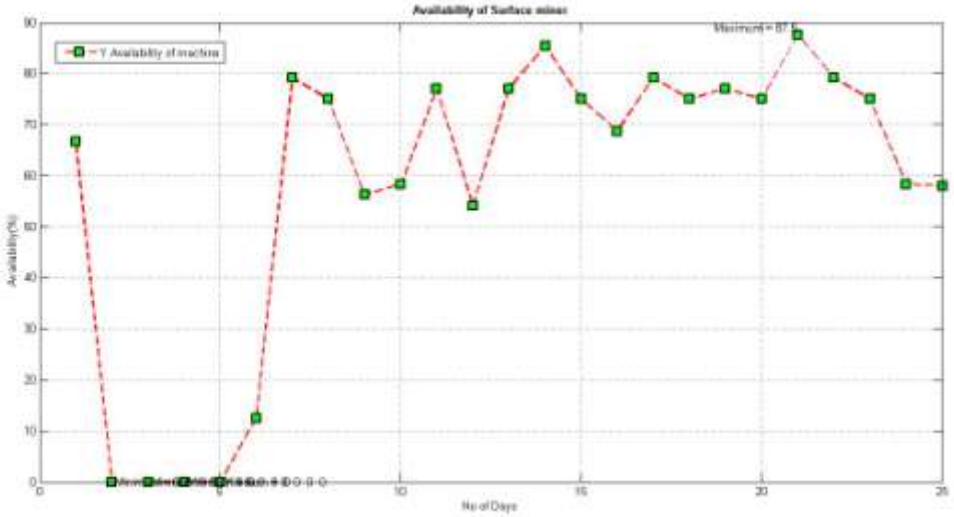

Figure 3.1 (d) Availability of SM-336(RUNGTA)

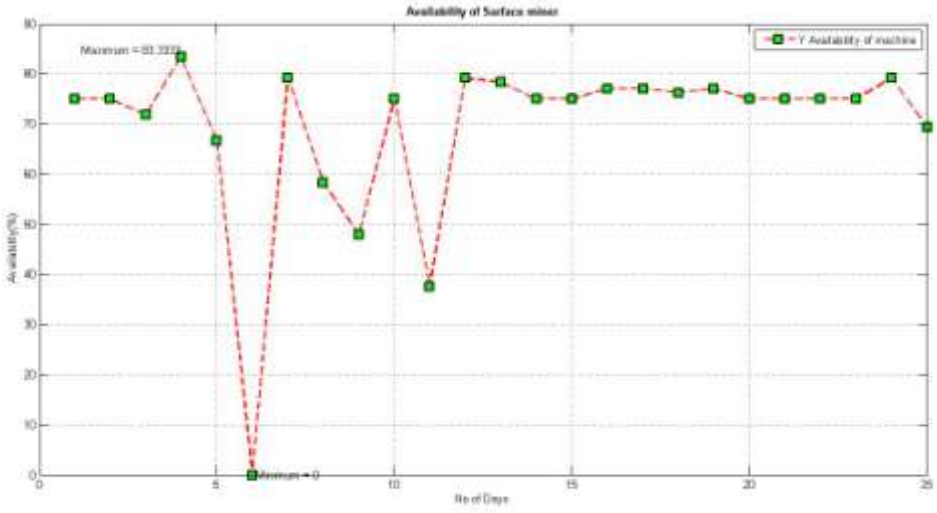

Figure 3.1 (e) Availability of SM-L&T-303(015)

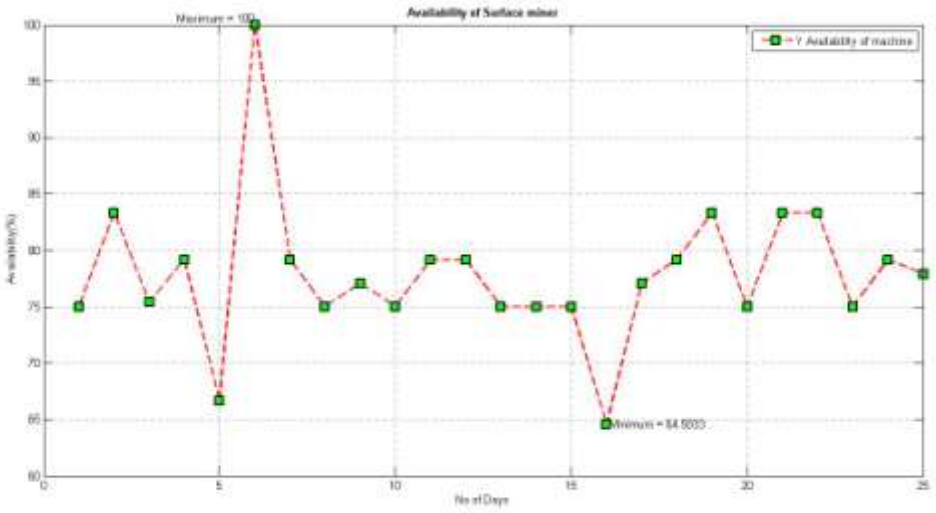

Figure 3.1 (f) Availability of SM-L&T-303(021)

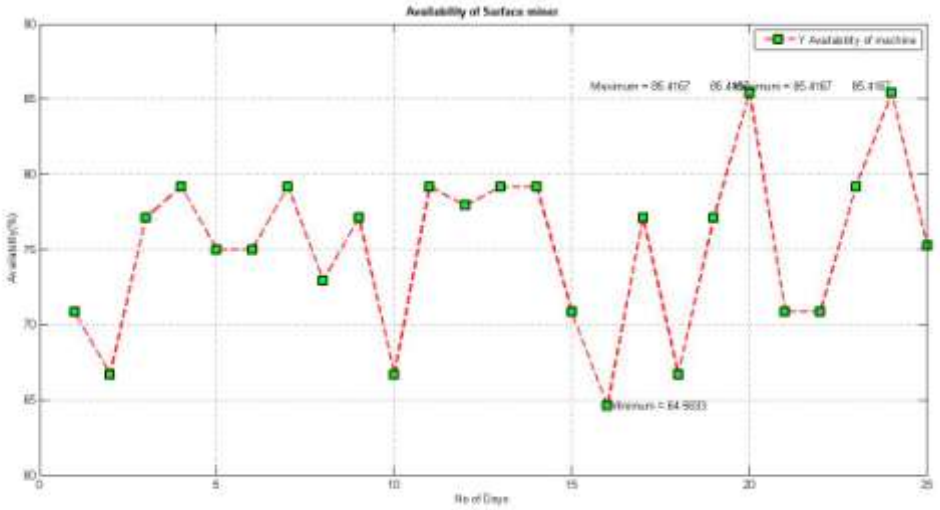

Figure 3.1 (g) Availability of SM-644(Nagarjuna)

2) Utilisation Graphs

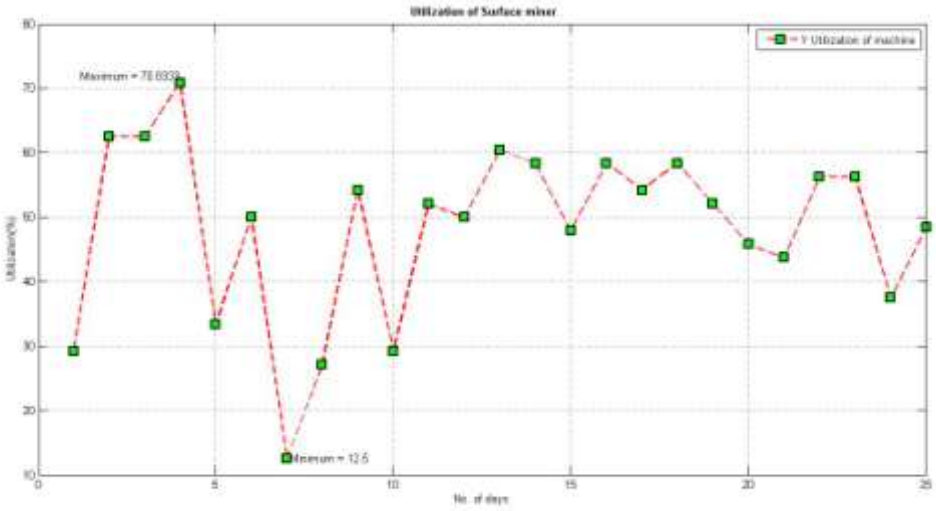

Figure 3.2 (a) Utilisation of SM-468(RUNGTA)

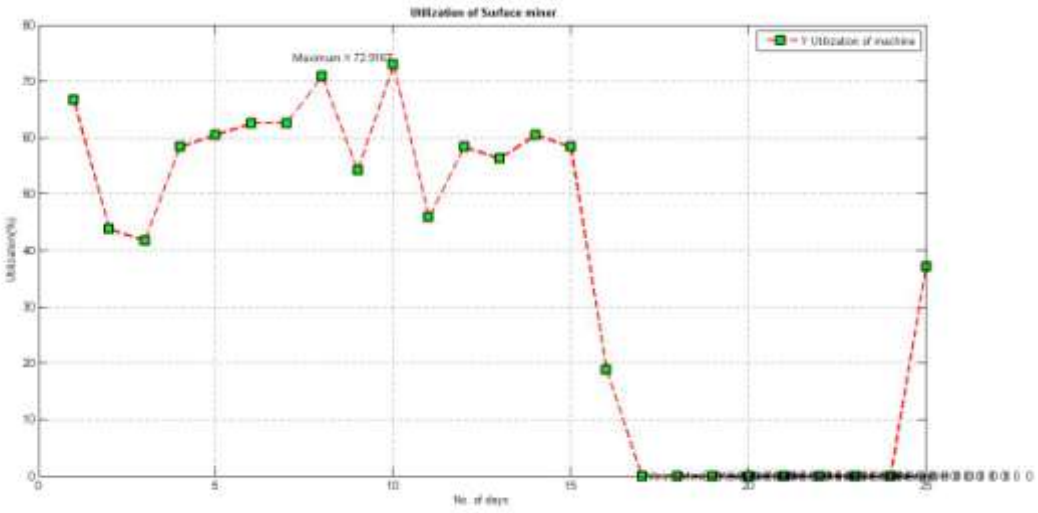

Figure 3.2 (b) Utilisation of SM-625(RUNGTA)

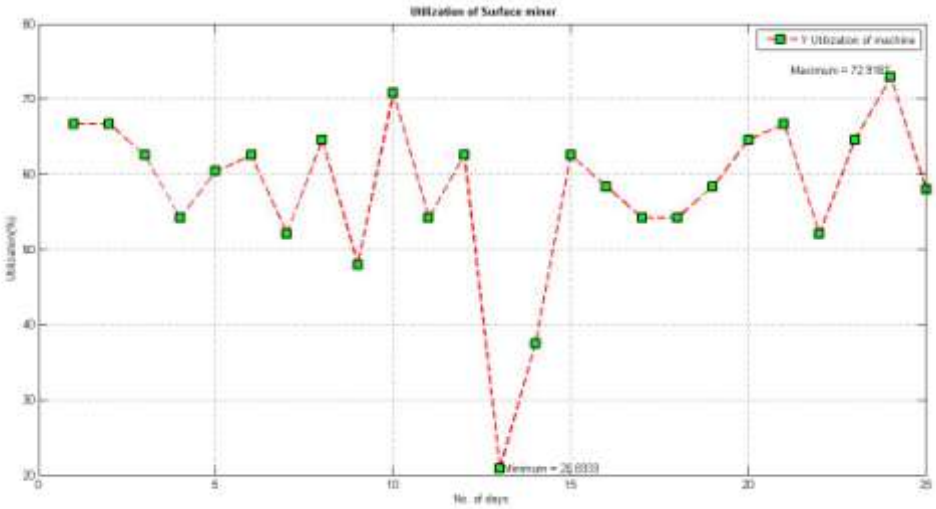

Figure 3.2 (c) Utilisation of SM-634(RUNGTA)

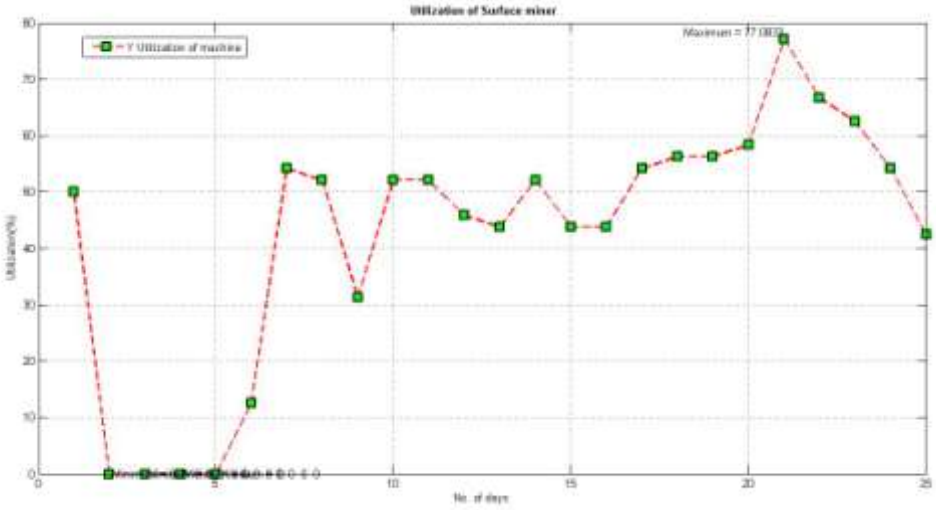

Figure 3.2 (d) Utilisation of SM-336(RUNGTA)

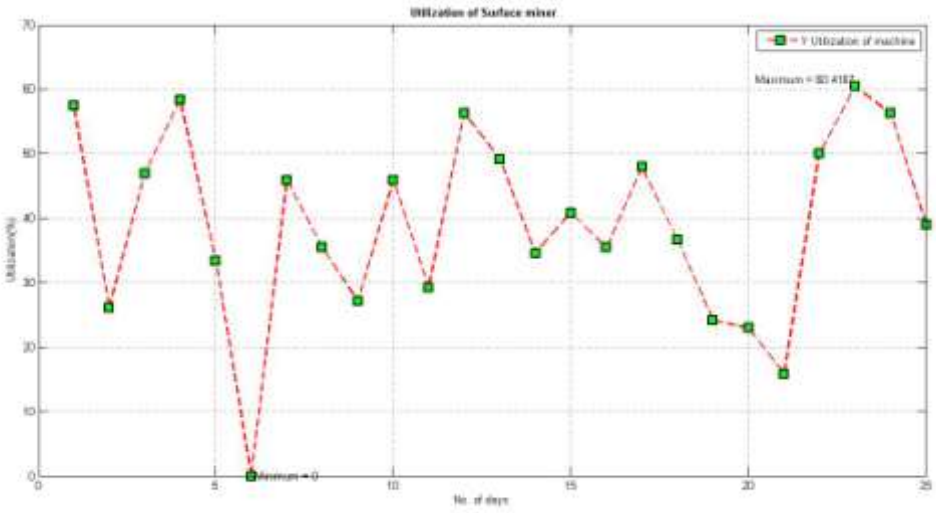

Figure 3.2 (e) Utilisation of SM- SM-L&T-303(015)

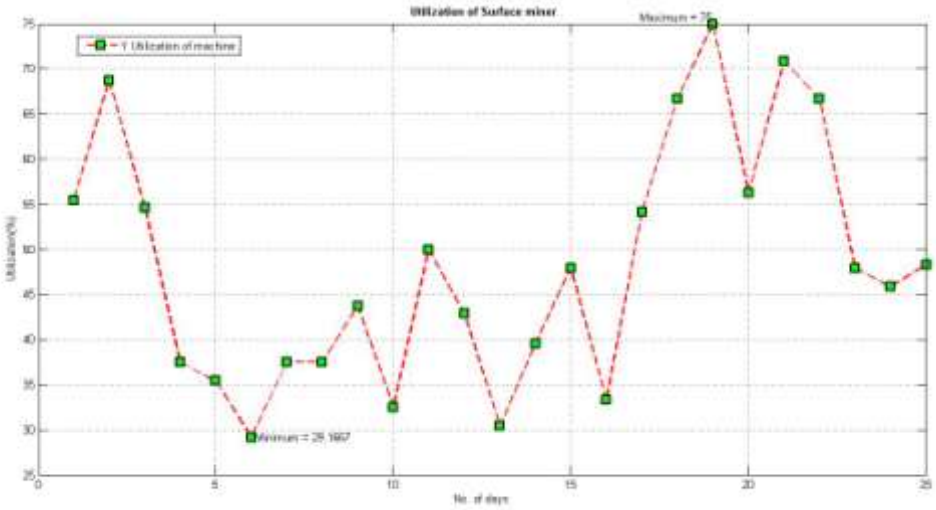

Figure 3.2 (f)) Utilisation of SM- SM-L&T-303(021)

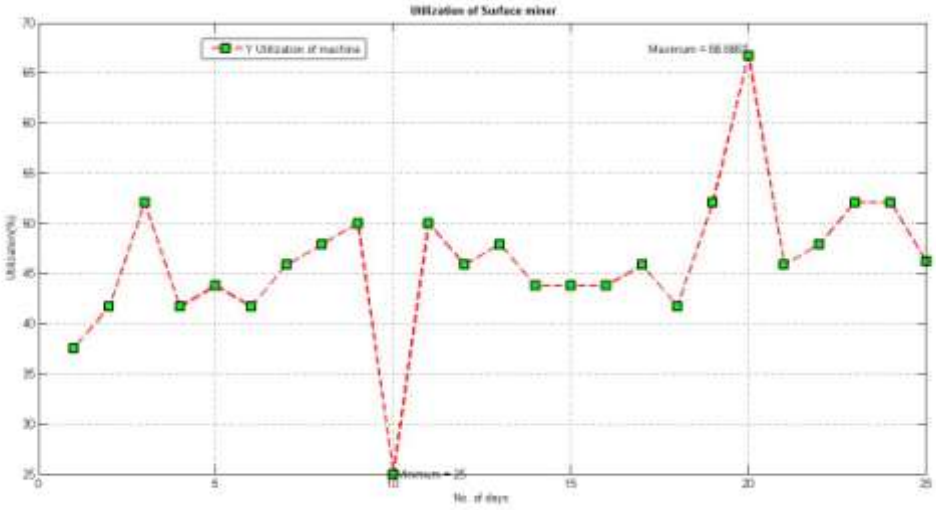

Figure 3.2 (g) Utilisation of SM-644(Nagarjuna)

3) Performance rate Graphs

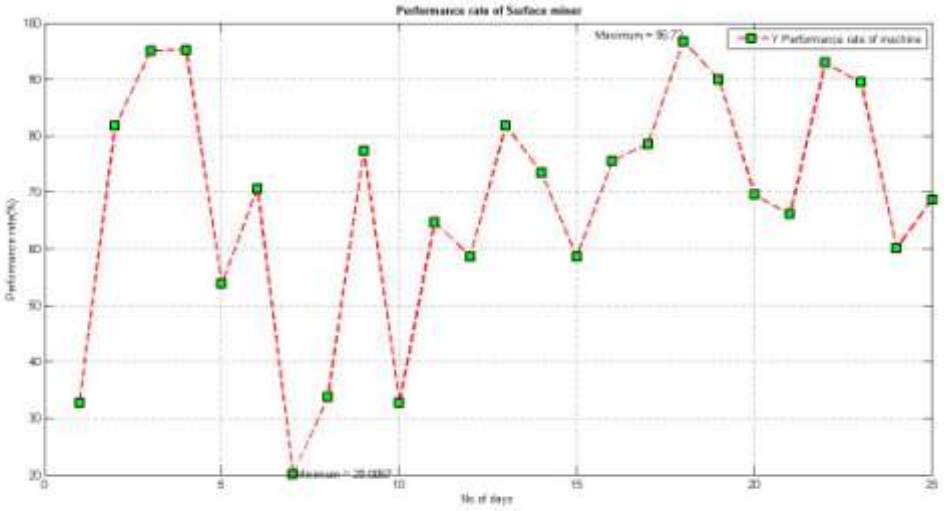

Figure 3.3 (a) Performance rate of SM-468(RUNGTA)

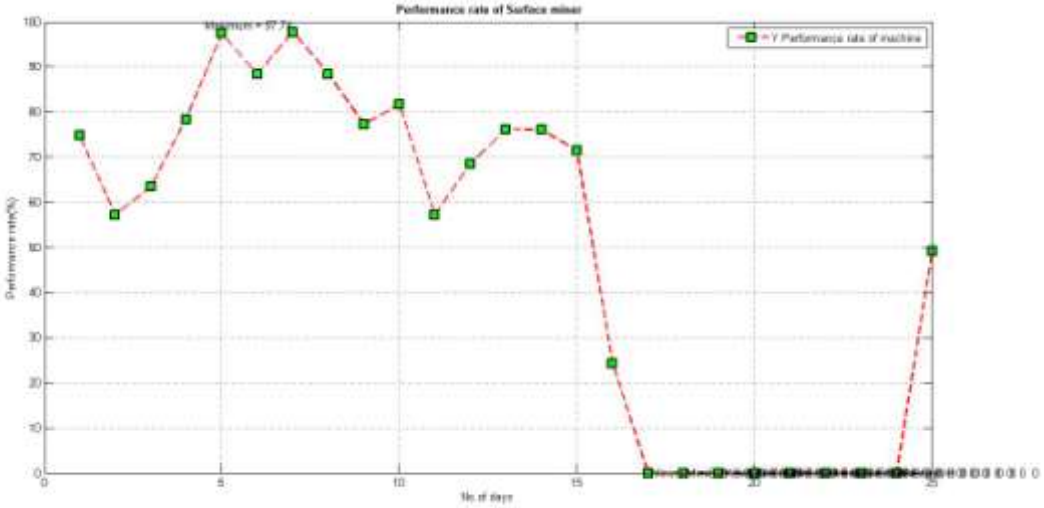

Figure 3.3 (b) Performance rate of SM-625(RUNGTA)

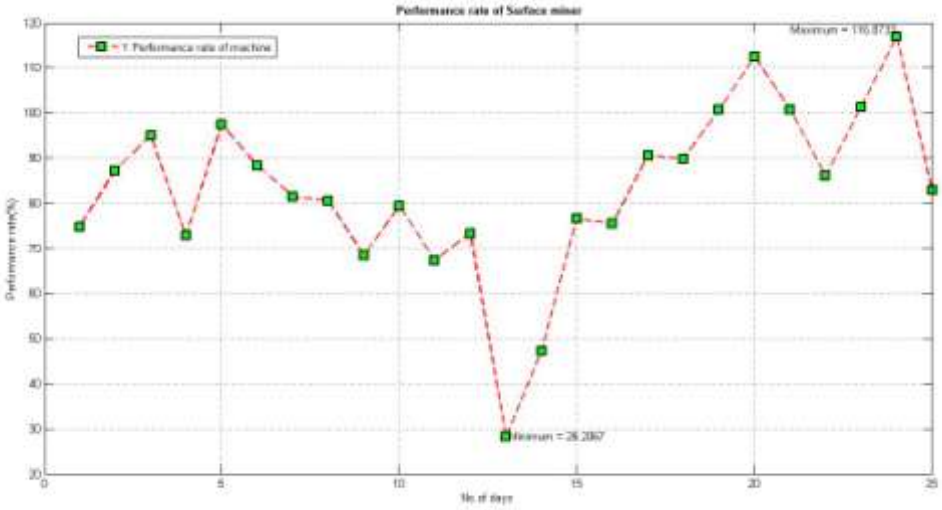

Figure 3.3 (c) Performance rate of SM-634(RUNGTA)

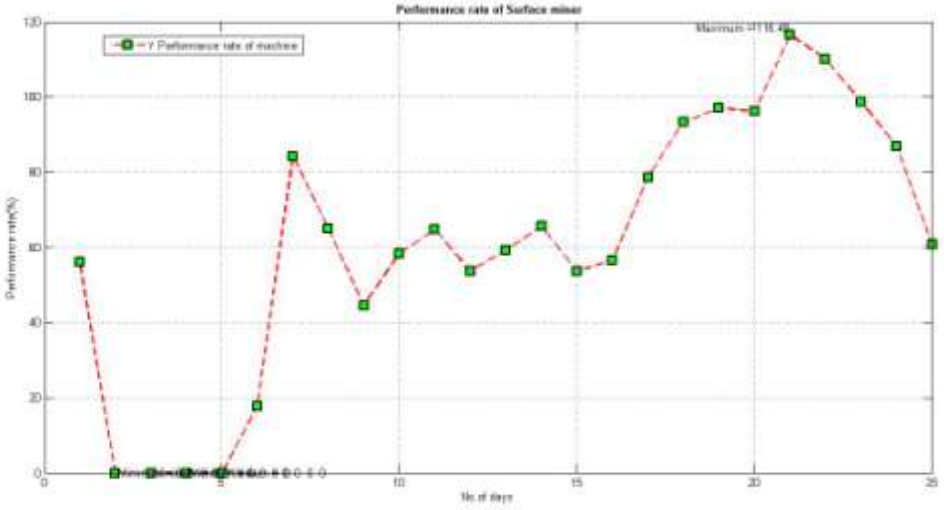

Figure 3.3 (d) Performance rate of SM-336(RUNGTA)

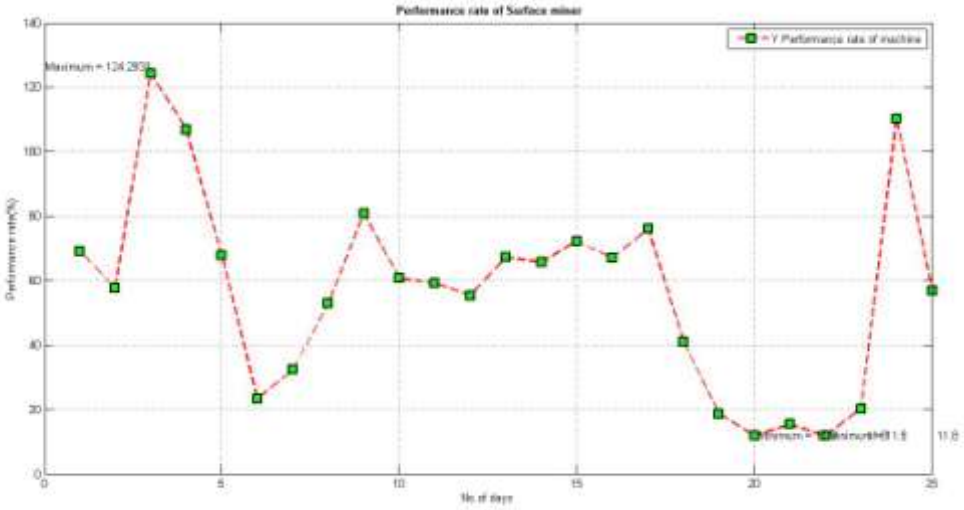

Figure 3.3 (e) Performance rate of SM-L&T-303(015)

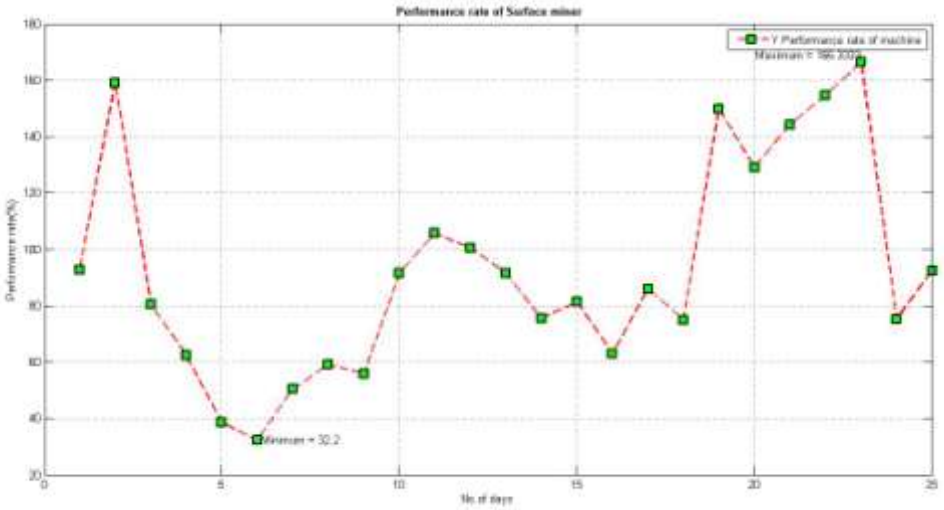

Figure 3.3 (f) Performance rate of SM-L&T-303(021)

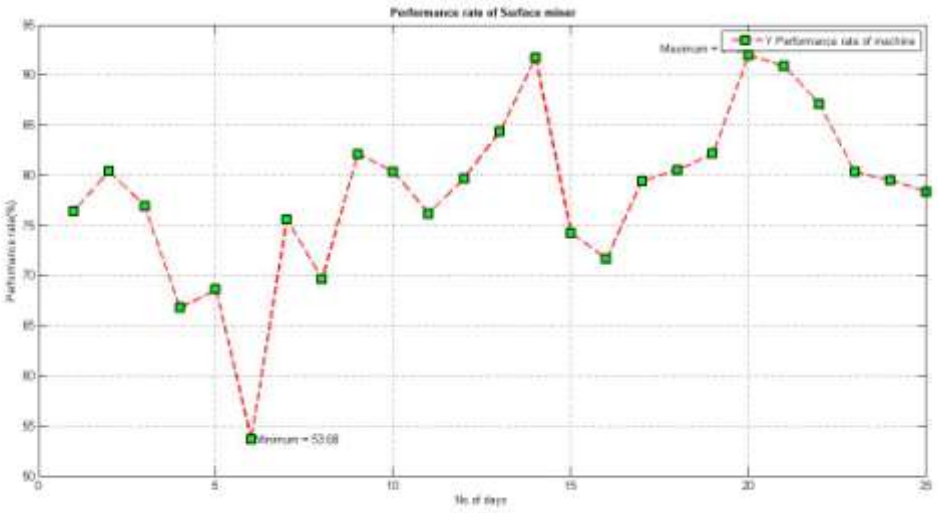

Figure 3.3(g) Performance rate of SM-644(NAGARJUNA)

4) Theoretical OEE and Estimated OEE graphs

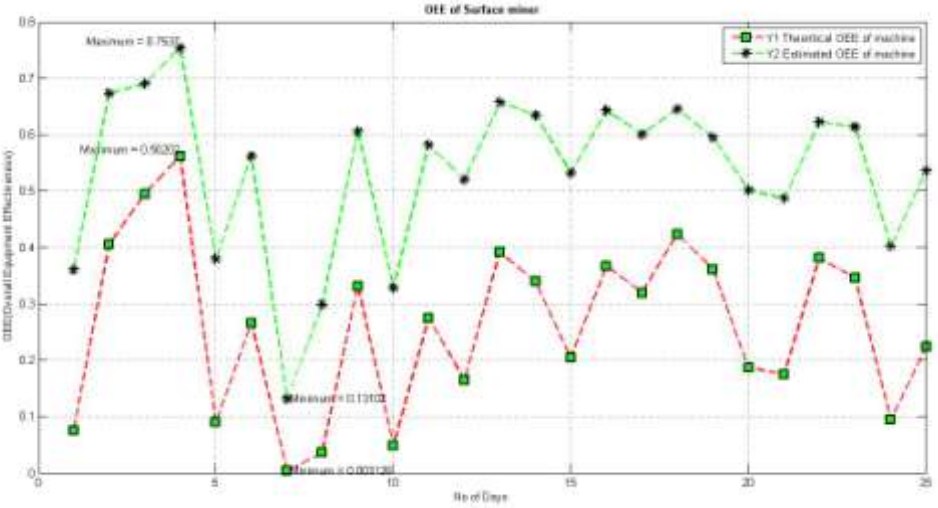

Figure 3.4 (a) Theoretical OEE and Estimated OEE of SM-468(RUNGTA)

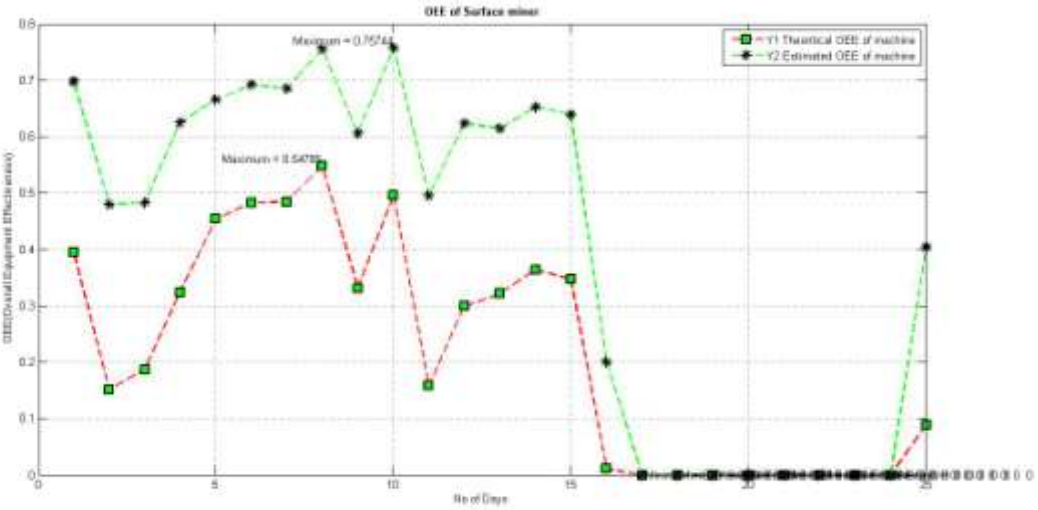

Figure 3.4 (b) Theoretical OEE and Estimated OEE of SM-625(RUNGTA)

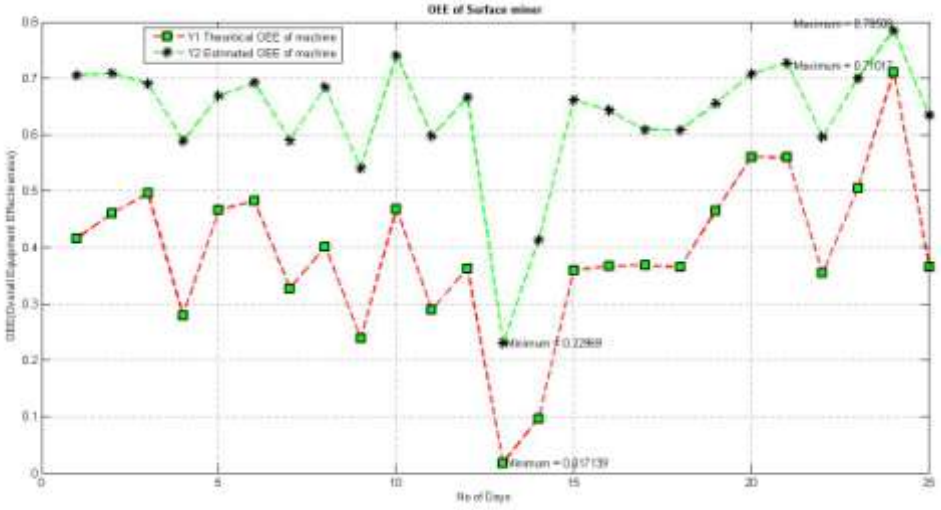

Figure 3.4 (c) Theoretical OEE and Estimated OEE of SM-634(RUNGTA)

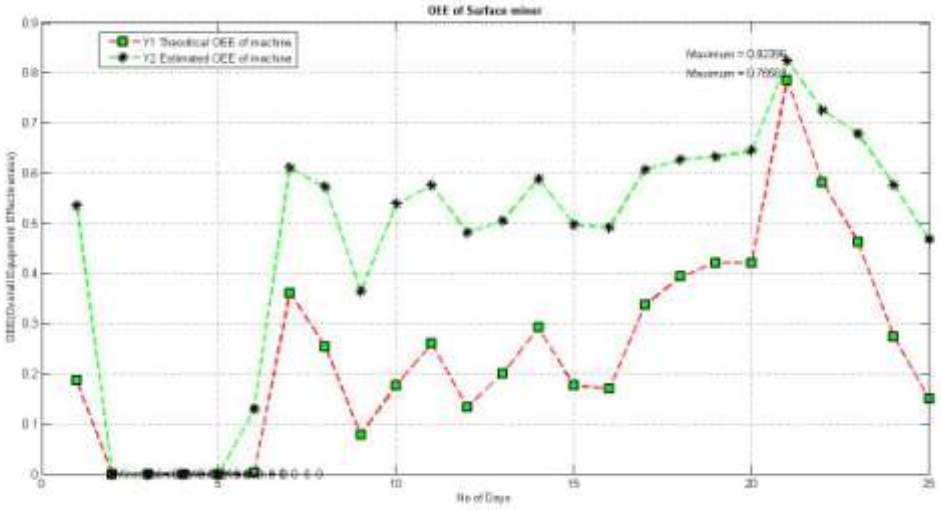

Figure 3.4 (d) Theoretical OEE and Estimated OEE of SM-336(RUNGTA)

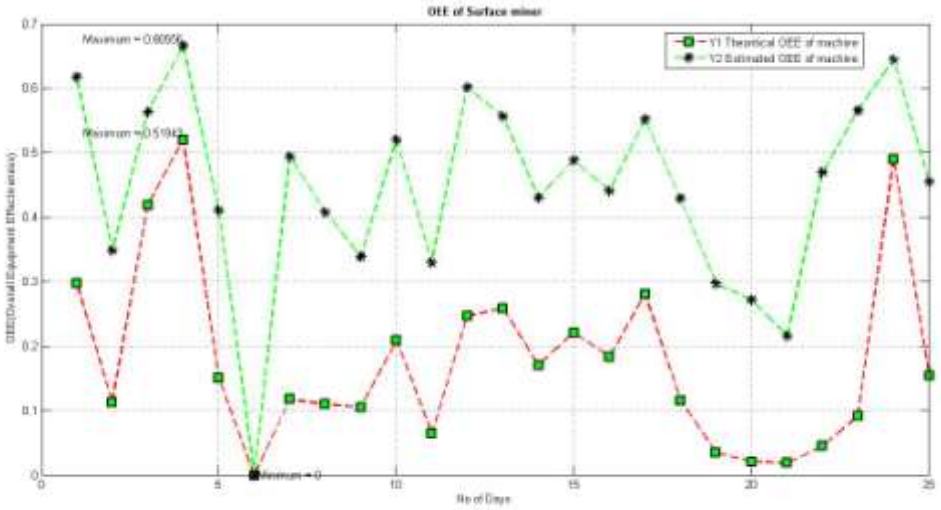

Figure 3.4 (e) Theoretical OEE and Estimated OEE of SM-L&T-303(015)

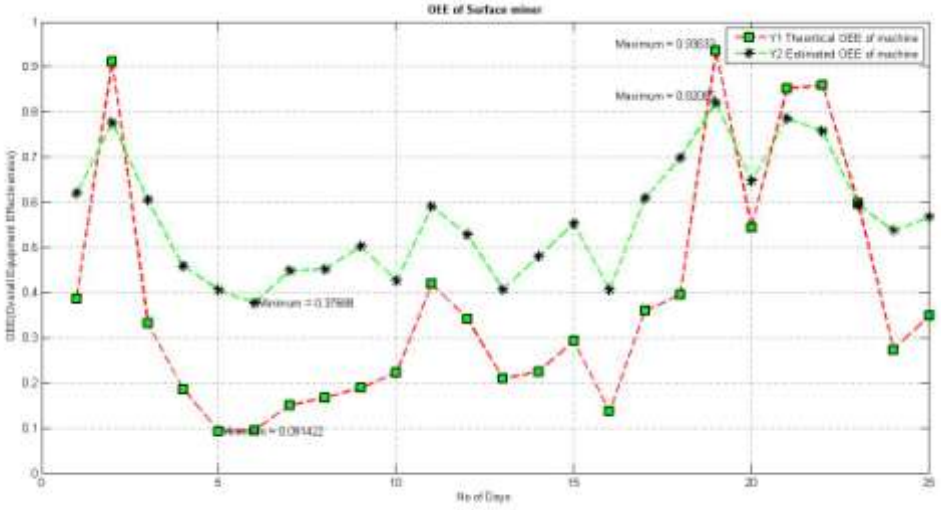

Figure 3.4 (f) Theoretical OEE and Estimated OEE of SM-L&T-303(021)

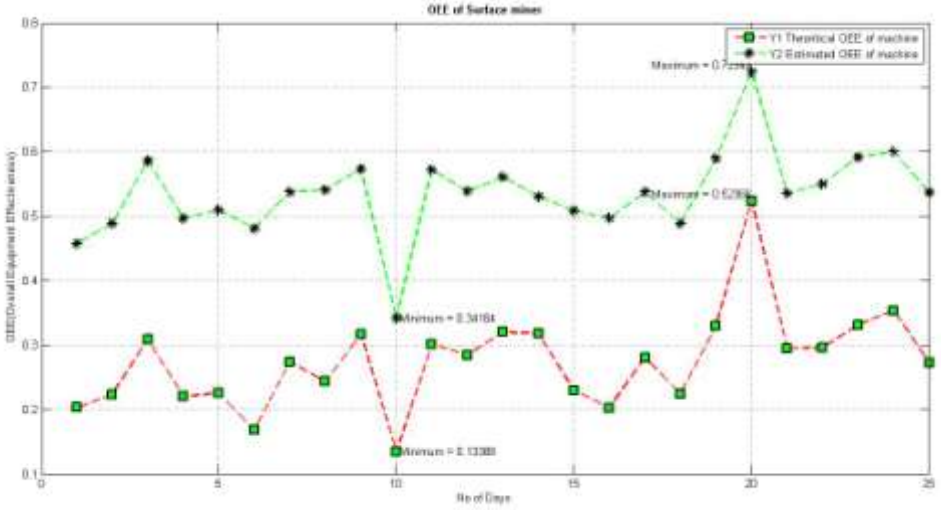

Figure 3.4 (g) Theoretical OEE and Estimated OEE of SM-644(NAGARJUNA)

5) Achieved Production graphs

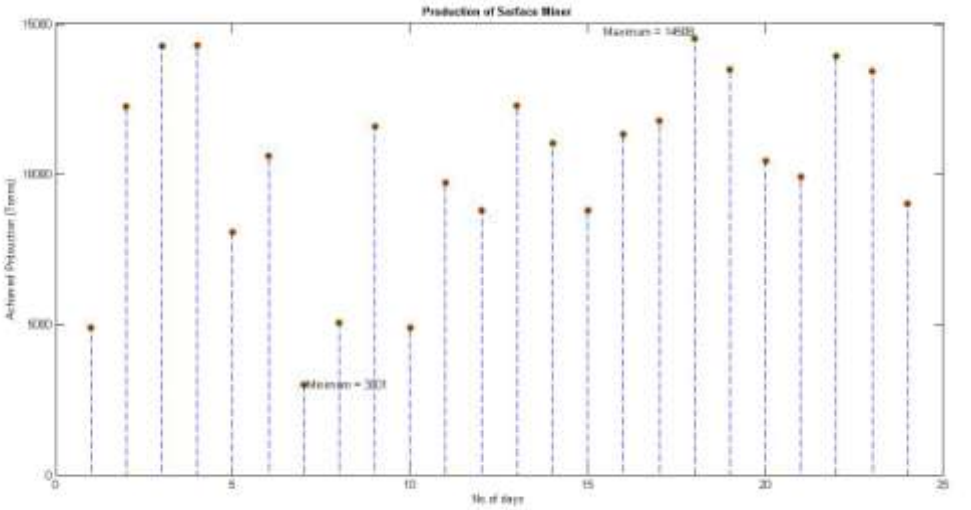

Figure 3.5 (a) Achieved Production of SM-468(RUNGTA)

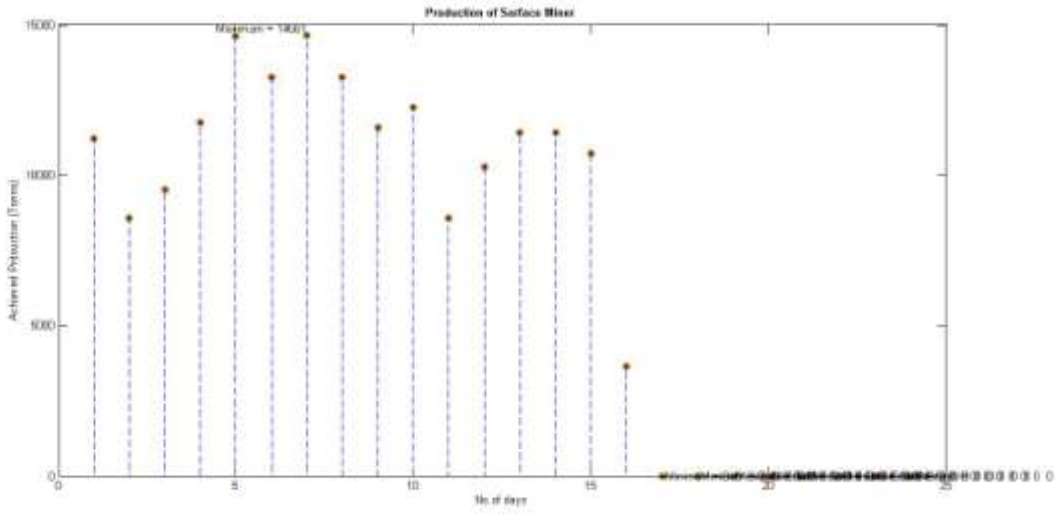

Figure 3.5 (b) Achieved Production of SM-625(RUNGTA)

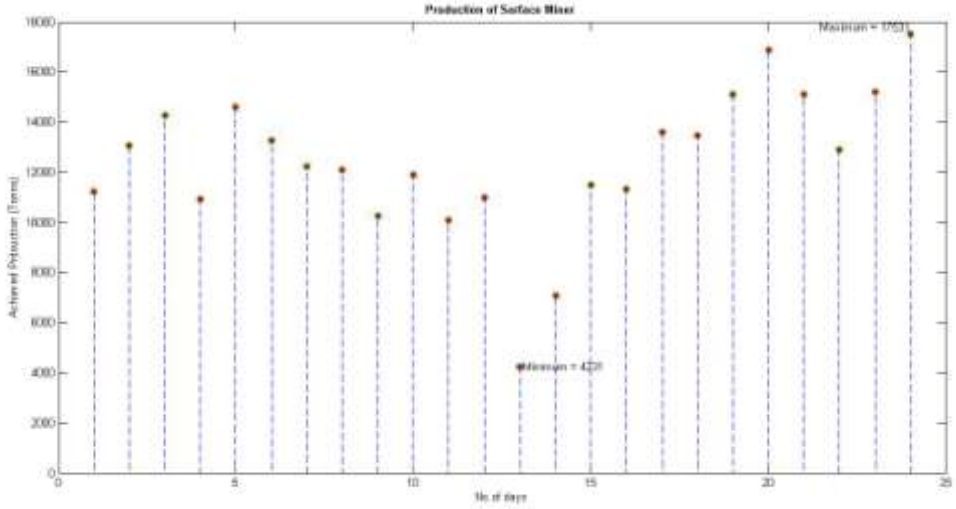

Figure 3.5 (c) Achieved Production of SM-634(RUNGTA)

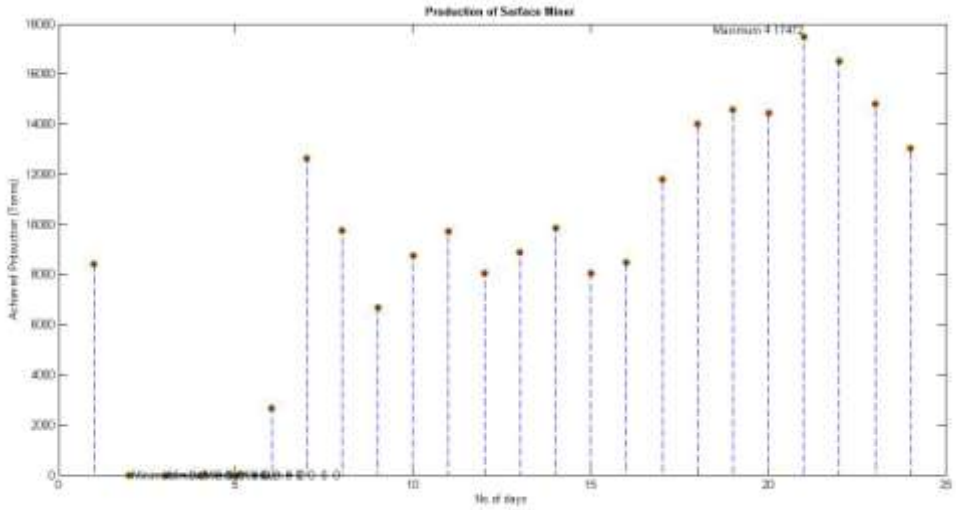

Figure 3.5 (d) Achieved Production of SM-336(RUNGTA)

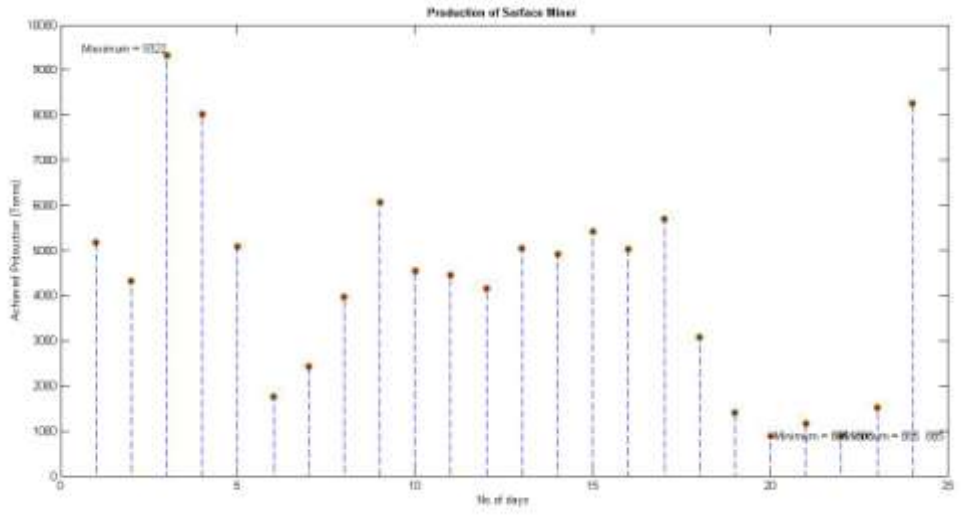

Figure 3.5 (e) Achieved Production of SM- L&T-303(015)

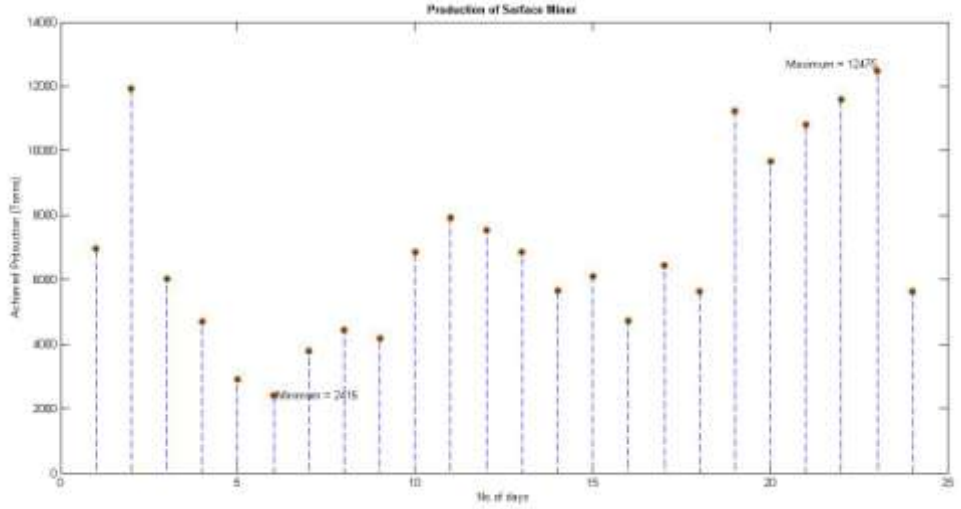

Figure 3.5 (f) Achieved Production of SM-L&T-303(021)

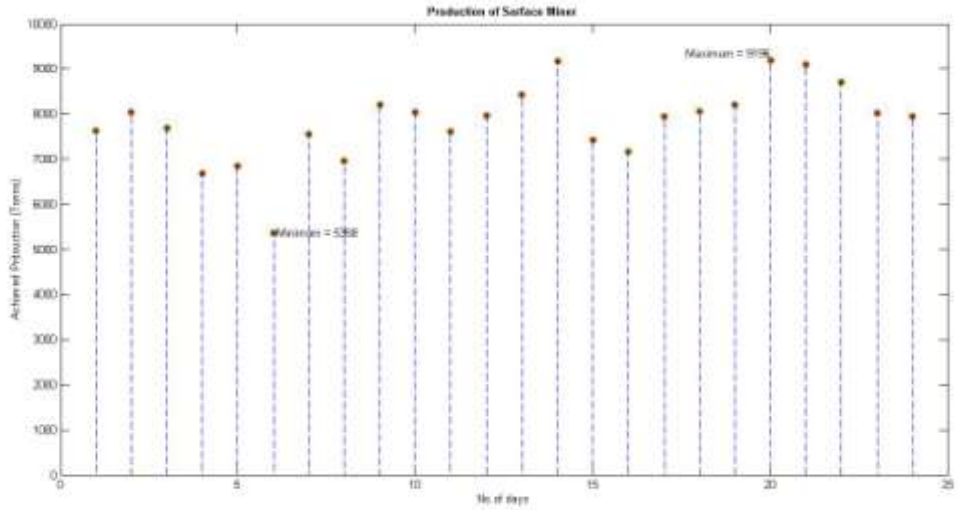

Figure 3.5 (g) Achieved Production of SM-644(NAGARJUNA)

6) Breakdown hours graph

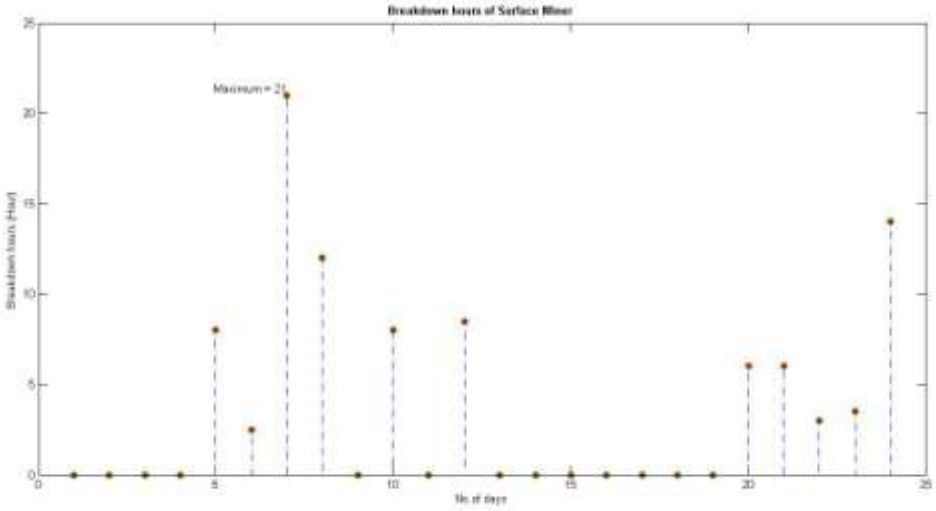

Figure 3.6 (a) Breakdown hours of SM-468(RUNGTA)

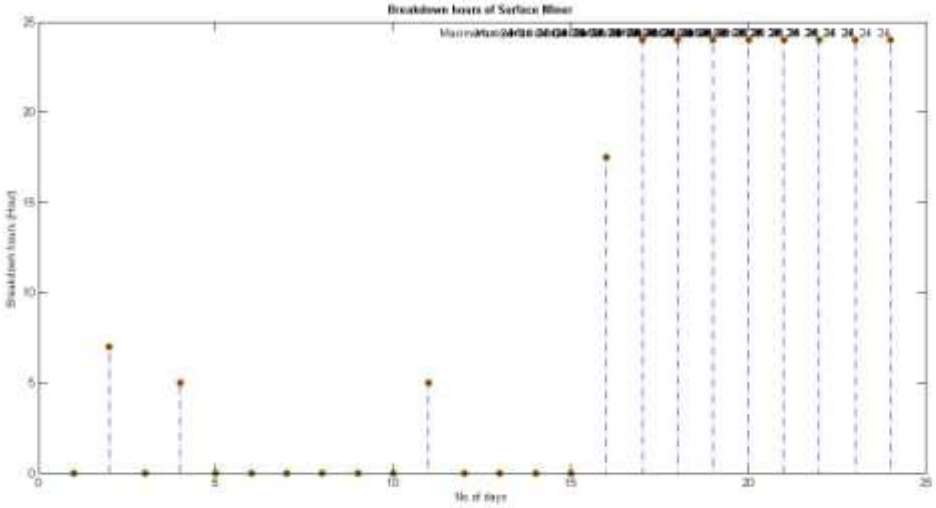

Figure 3.6 (b) Breakdown hours of SM-625(RUNGTA)

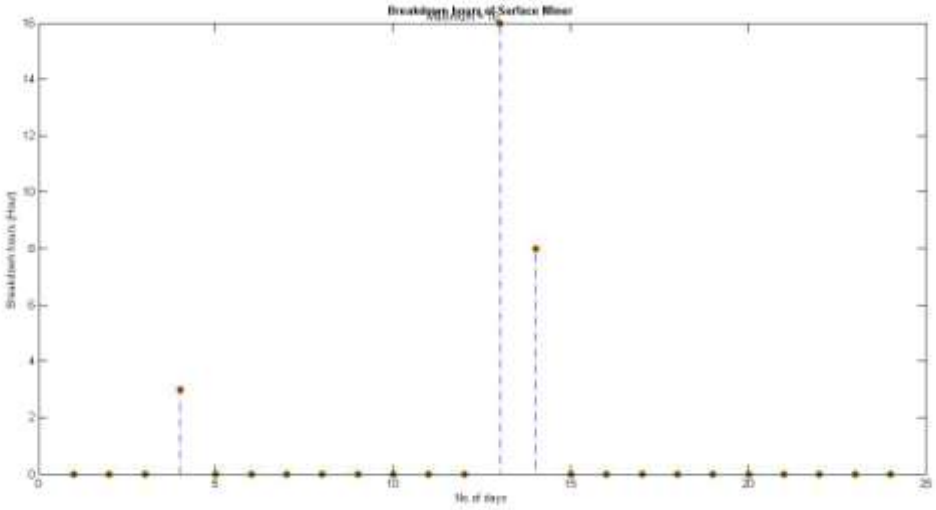

Figure 3.6 (c) Breakdown hours of SM-634(RUNGTA)

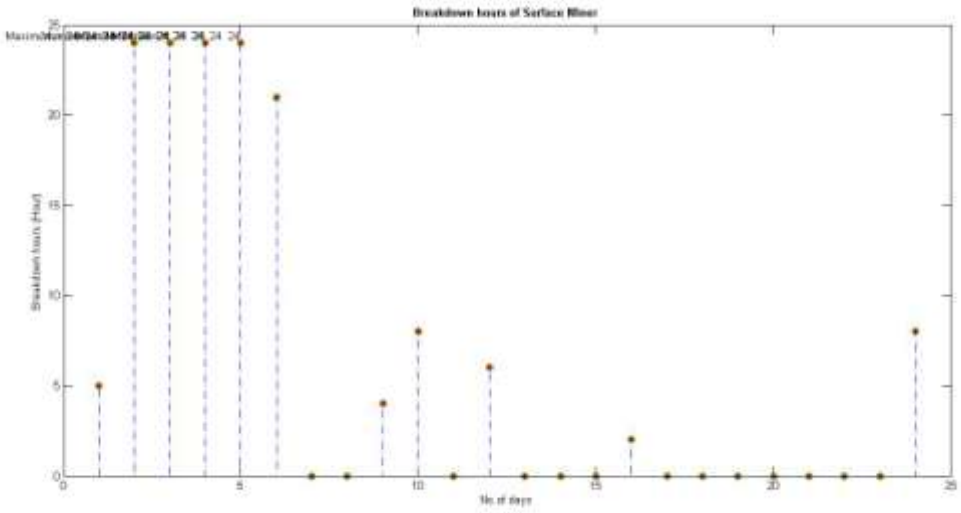

Figure 3.6 (d) Breakdown hours of SM-336(RUNGTA)

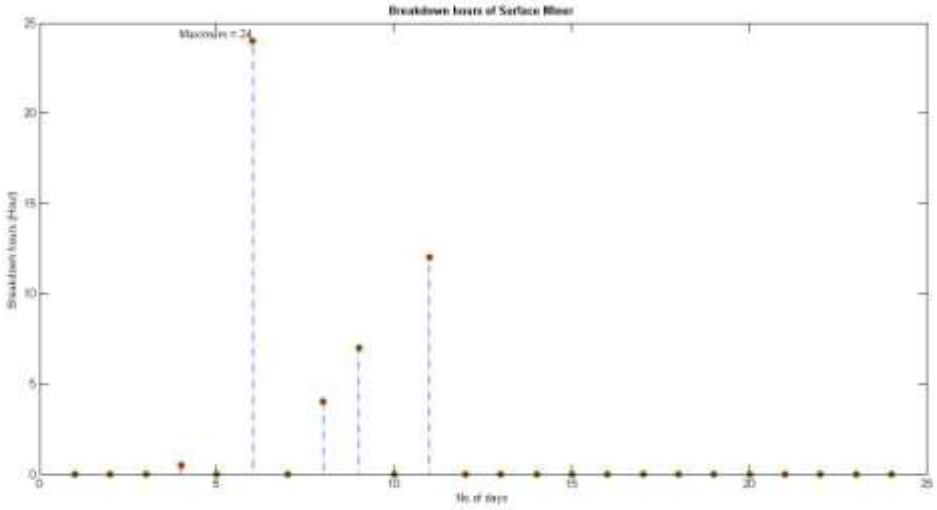

Figure 3.6 (e) Breakdown hours of SM-L&T-303(015)

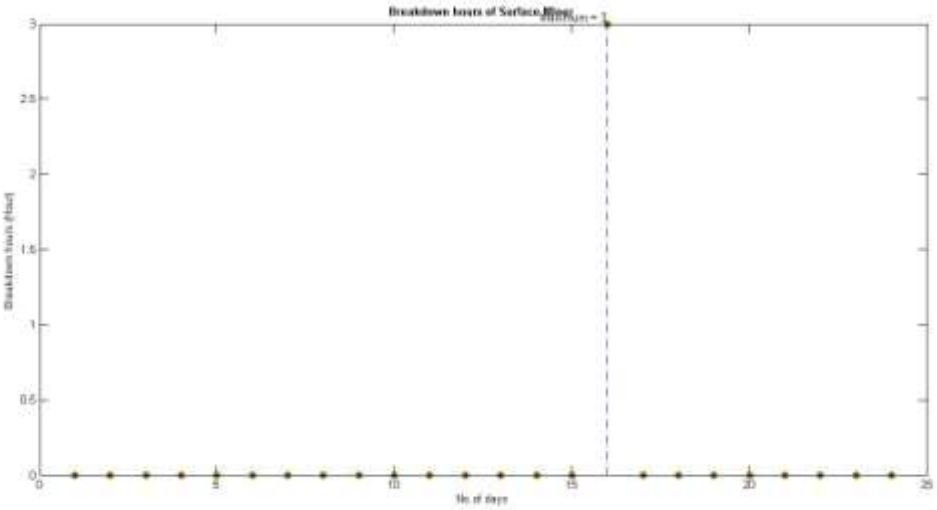

Figure 3.6 (f) Breakdown hours of SM-L&T-303(021)

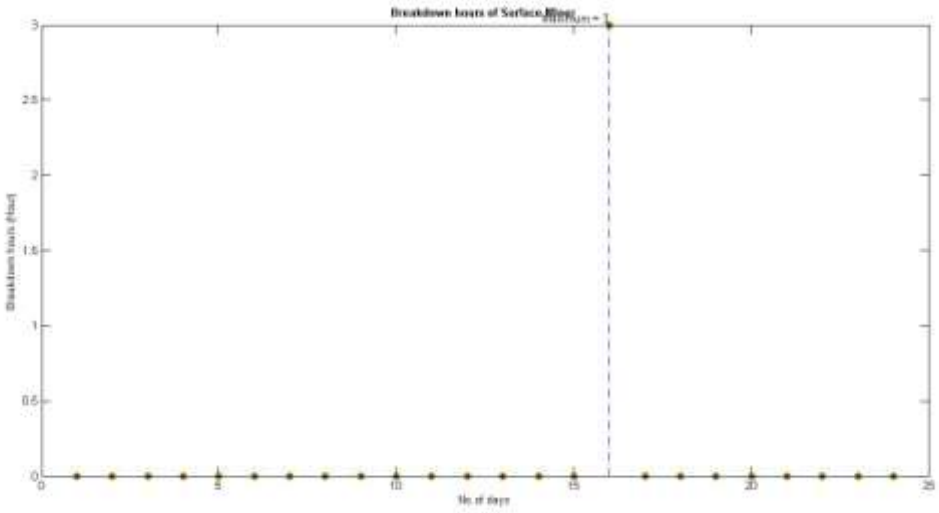

Figure 3.6 (g) Breakdown hours of SM-644(NAGARJUNA)

7) Idle hours graphs

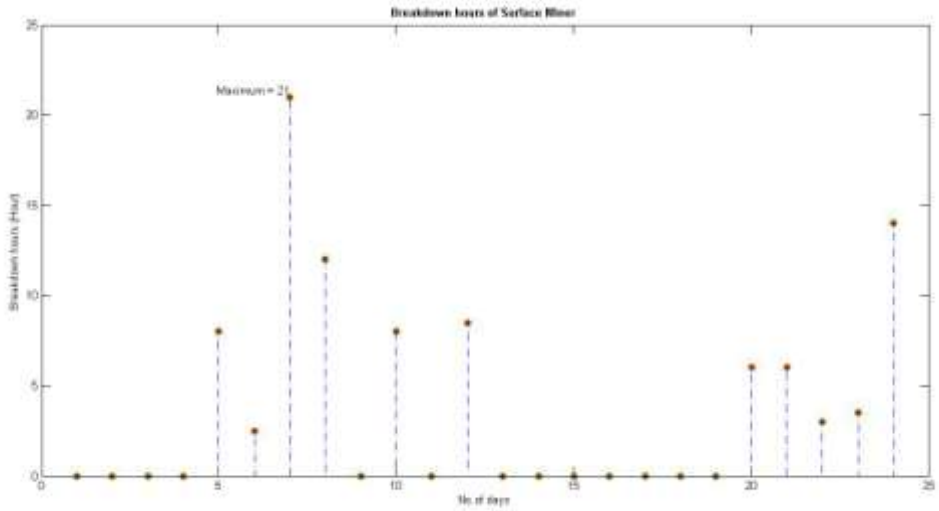

Figure 3.7 (a) Idle hours of SM-468(RUNGTA)

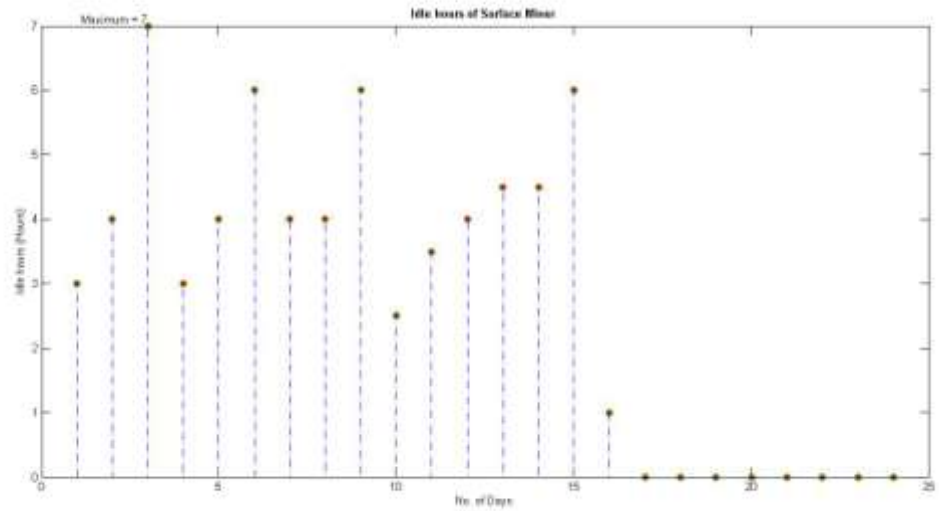

Figure 3.7 (b) Idle hours of SM-625(RUNGTA)

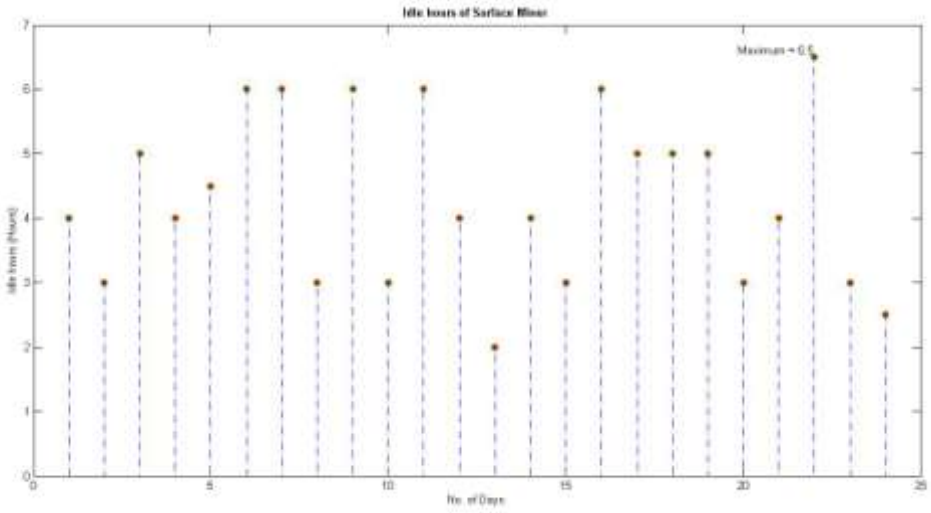

Figure 3.7 (c) Idle hours of SM-634(RUNGTA)

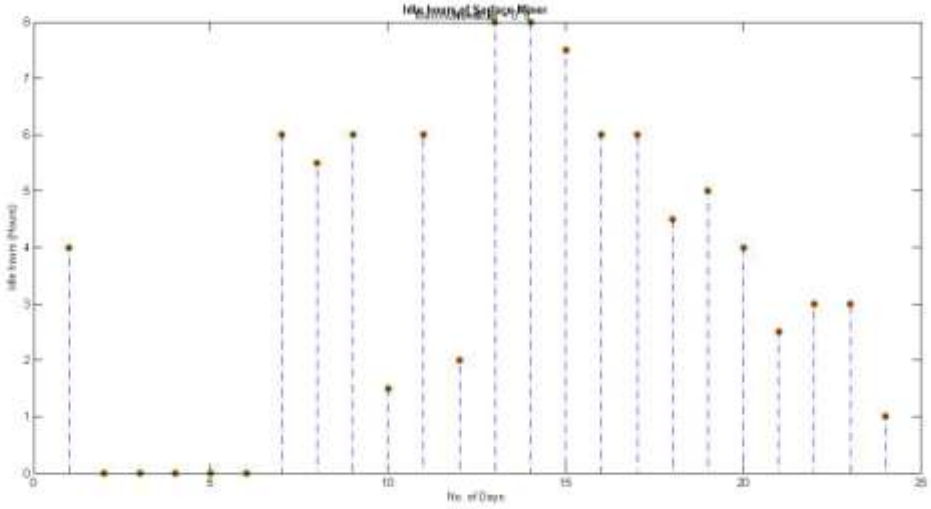

Figure 3.7 (d) Idle hours of SM-336(RUNGTA)

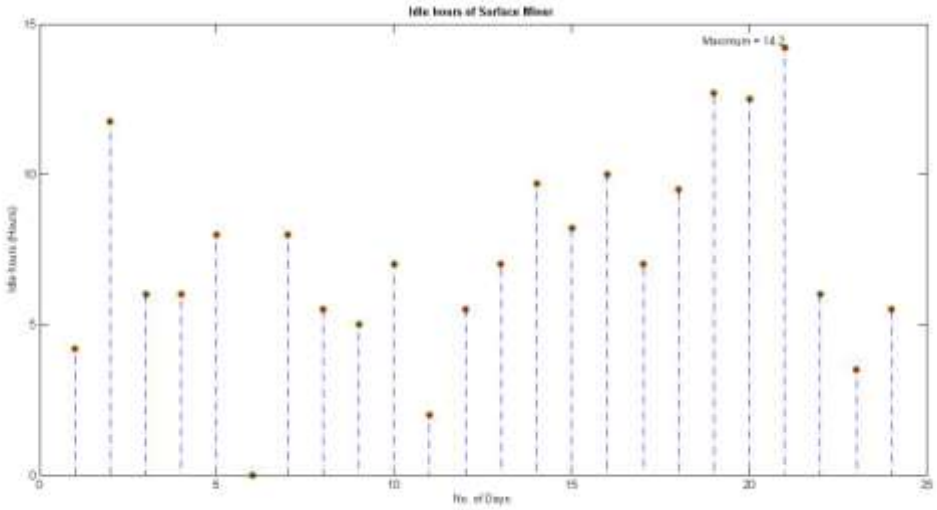

Figure 3.7 (e) Idle hours of SM-L&T-303(015)

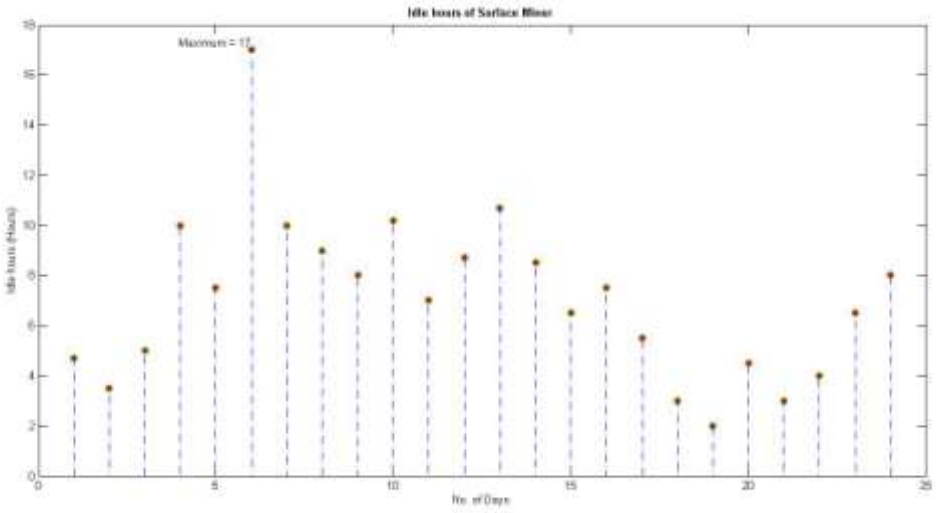

Figure 3.7 (f) Idle hours of SM-L&T-303(021)

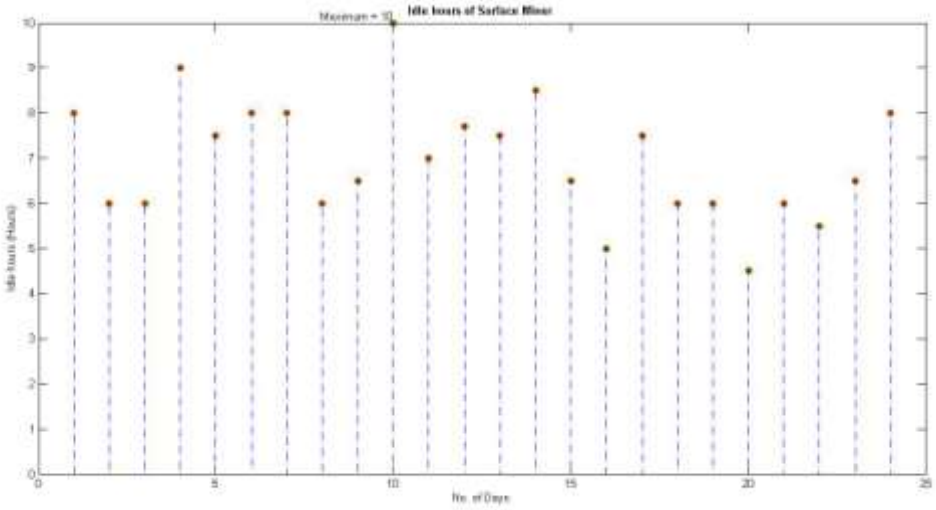

Figure 3.7 (g) Idle hours of SM-644(NAGARJUNA)

3.3 DAILY PERFORMANCE OF SURFACE MINER (L&T KSM 303(24)) AT SAMALESWARI OCP

Table 3.8: Performance of Surface miner L&T KSM 303(24) from 26th Dec to 25th Jan at Samaleswari OCP

Date	S/T	W/H	M/H	I/H	B/H	Availability	Utilisation	Target Production(T)	Achieved Production(T)	Performance rate	Theoretical OEE	Estimated OEE
26.12.14	24	14	1	8	1	91.67	58.33	10000	9542.67	95.43	0.5103	0.6707
27.12.14	24	17	1	6	0	95.83	70.83	10000	8860.49	88.60	0.6015	0.7695
28.12.14	24	16	1	7	0	95.83	66.67	10000	8663.81	86.64	0.5535	0.7359
29.12.14	24	16	1	7	0	95.83	66.67	10000	10670.3	106.70	0.6817	0.7514
30.12.14	24	16	1	7	0	95.83	66.67	10000	9156	91.56	0.5850	0.74
31.12.14	24	16	1	7	0	95.83	66.67	10000	6974	69.74	0.4456	0.7201
01.12.15	24	15	1	8	0	95.83	62.50	10000	7629	76.29	0.4569	0.6945
02.12.15	24	15	1	8	0	95.83	62.50	10000	6903	69.03	0.4135	0.6876
03.12.15	24	14	1	9	0	95.83	58.33	10000	8725.66	87.26	0.4878	0.6707
04.12.15	24	16	1	7	3	95.83	66.67	10000	8922	89.22	0.57	0.7380
05.12.15	24	15	1	5	0	83.33	62.50	10000	9960	99.60	0.5188	0.6936
06.12.15	24	0	0	24	0	100	0	10000	0	0	0	0
07.12.15	24	0	0	24	0	100	0	10000	1552	15.52	0	0
08.12.15	24	16	1	7	0	95.83	66.67	10000	9449	94.49	0.6037	0.7423
09.12.15	24	16	1	7	0	95.83	66.67	10000	10525	105.25	0.6724	0.7503
10.01.15	24	17	1	6	0	95.83	70.83	10000	10768	107.68	0.7310	0.7847
11.01.15	24	17	1	4	2	87.50	70.83	10000	9816	98.16	0.6084	0.7634
12.01.15	24	17	2	5	0	91.67	70.83	10000	9386	93.86	0.6094	0.7671
13.01.15	24	18	1	5	0	95.83	75	10000	13008	130.08	0.9350	0.8323
14.01.15	24	1	0	2	21	12.50	4.17	10000	1027	10.27	0.0005	0.0568
15.01.15	24	0	0	0	24	0	0	10000	0	0	0	0
16.01.15	24	0	0	0	24	0	0	10000	0	0	0	0
17.01.15	24	6	0	2	16	33.33	25	10000	3530	35.30	0.0294	0.2741
18.01.15	24	15	0	3	6	75	62.50	10000	8961	89.61	0.42	0.6720
19.01.15	24	16	1	5	2	87.50	66.67	10000	10868	108.68	0.6340	0.7392
20.01.15	24	17	1	5	1	91.67	70.83	10000	8992	89.92	0.5839	0.7638
21.01.15	24	17	1	4.5	1.5	89.58	70.83	10000	9599	95.99	0.6091	0.7653
22.01.15	24	18	1	5	0	95.83	75	10000	9566	95.66	0.6876	0.8071
23.01.15	24	18	1	5	0	95.83	75	10000	10950	109.50	0.7870	0.8181
24.01.15	24	17	1	1	5	75	70.83	10000	9902	99.02	0.5260	0.7409
25.01.15	24	14	1	4	5	75	58.33	10000	7361	73.61	0.3220	0.6278
OVERALL	744	410	25	197.5	111.5	81.65	55.11	310000	241266.93	77.83	0.3502	0.6171

S/T= Scheduled Time, W/H= Working Hour, M/H= Maintenance Hour, I/H= Idle Hour, B/H= Breakdown Hour

Table 3.9: Performance of Surface miner L&T KSM 303(24) from 26th Jan to 25th Feb at Samaleswari OCP

Date	S/T	W/H	M/H	I/H	B/H	Availability	Utilisation	Target Production(T)	Achieved Production(T)	Performance rate	Theoretical OEE	Estimated OEE
26.01.15	24	19	1	4	0	95.83	79.17	10000	8635	86.35	0.6551	0.8297
27.01.15	24	19	1	4	0	95.83	79.17	10000	9961	99.61	0.7557	0.8416
28.01.15	24	16	1	4	3	83.33	66.67	10000	11197	111.97	0.6221	0.7342
29.01.15	24	18	1	3	2	87.50	75	10000	15500	155	1.0172	0.8317
30.01.15	24	17	1	4	2	87.50	70.83	10000	11064	110.64	0.6857	0.7726
31.01.15	24	17	1	2.5	3.5	81.25	70.83	10000	9189	91.89	0.5288	0.7472
01.02.15	24	19	1	3	1	91.67	79.17	10000	4859	48.59	0.3526	0.7764
02.02.15	24	17	1	6	0	95.83	70.83	10000	9233	92.33	0.6268	0.7727
03.02.15	24	16	1	4	3	83.33	66.67	10000	8134	81.34	0.4519	0.7111
04.02.15	24	18	2	4	0	91.67	75	10000	9970	99.70	0.854	0.8033
05.02.15	24	16	1	4.5	2.5	85.42	66.67	10000	8727	87.27	0.4970	0.7197
06.02.15	24	18	1	4.5	0.5	93.75	75	10000	9029	90.29	0.6349	0.7989
07.02.15	24	16	1	5.5	1.5	89.58	66.67	10000	7521	75.21	0.4492	0.7158
08.02.15	24	18	1	5	0	95.83	75	10000	10257	102.57	0.7372	0.8127
09.02.15	24	18	1	4	1	91.67	75	10000	10225	102.25	0.7030	0.8053
10.02.15	24	20	1	3	0	95.83	83.33	10000	12006	120.06	0.9588	0.8888
11.02.15	24	20	1	3	0	95.83	83.33	10000	10225	102.25	0.8166	0.8747
12.02.15	24	18	2	5	0	95.83	75	10000	11089	110.89	0.7970	0.8191
13.02.15	24	19	1	4	0	95.83	79.17	10000	12295	122.95	0.9328	0.8595
14.02.15	24	19	1	4	0	95.83	79.17	10000	9063	90.63	0.6876	0.8337
15.02.15	24	18	1	5	0	95.83	75	10000	11654	116.54	0.8376	0.8232
16.02.15	24	17	1	5.5	0.5	93.75	70.83	10000	10336	103.36	0.6864	0.7780
17.02.15	24	18	2	4	0	91.67	75	10000	9352	93.52	0.6430	0.7981
18.02.15	24	18	1	5	0	95.83	75	10000	10345	103.45	0.7435	0.8134
19.02.15	24	20	1	3	0	95.83	83.33	10000	8395	83.95	0.6704	0.8576
20.02.15	24	19	1	4	0	95.83	79.17	10000	9571	95.71	0.7261	0.8383
21.02.15	24	19	1	4	0	95.83	79.17	10000	11452	114.52	0.8688	0.8534
22.02.15	24	16	0	1	7	70.83	66.67	10000	8059	80.59	0.3806	0.6877
23.02.15	24	18	1	2.5	2.5	85.42	75	10000	992	96.92	0.6209	0.7898
24.02.15	24	19	1	4	0	95.83	79.17	10000	9464	94.64	0.7180	0.8373
25.02.15	24	13	1	1.5	8.5	60.42	54.17	10000	8555	85.55	0.2800	0.5795
OVERALL	744	553	33	120.5	38.5	90.52	74.33	310000	305054	98.40	0.6621	0.7952

S/T= Scheduled Time, W/H= Working Hour, M/H= Maintenance Hour, I/H= Idle Hour, B/H= Breakdown Hour

Table 3.10: Performance of Surface miner L&T KSM 303(24) from 26th Feb to 25th Mar at Samaleswari OCP

Date	S/T	W/H	M/H	I/H	B/H	Availability	Utilisation	Target Production(T)	Achieved Production(T)	Performance rate	Theoretical OEE	Estimated OEE
26.02.15	24	18	1	5	0	95.83	75	10000	11149	111.49	0.8013	0.8195
27.02.15	24	20	1	3	0	95.83	83.33	10000	13434	134.34	1.0729	0.8989
28.02.15	24	19	1	4	0	95.83	79.17	10000	10992	109.92	0.8339	0.8499
01.03.15	24	19	1	4	0	95.83	79.17	10000	9403	94.03	0.7134	0.8368
02.03.15	24	21	1	2	0	95.83	87.50	10000	10186	101.86	0.8541	0.9047
03.03.15	24	21	1	2	0	95.83	87.50	10000	11484	114.84	0.9630	0.9156
04.03.15	24	15	0	1.5	7.5	68.75	62.50	10000	8154	81.54	0.3504	0.6542
05.03.15	24	15	1	2	6	70.83	62.50	10000	8773	87.73	0.3884	0.6629
06.03.15	24	15	1	8	0	95.83	62.50	10000	4232	42.32	0.2535	0.6547
07.03.15	24	18	1	5	0	95.83	75	10000	10614	106.14	0.7629	0.8155
08.03.15	24	16	1	1	6	70.83	66.67	10000	9600	96	0.4533	0.6999
09.03.15	24	14	2	4.5	3.5	77.08	58.33	10000	7227	72.27	0.3250	0.6301
10.03.15	24	12	1	1	10	54.17	50	10000	5985	59.85	0.1621	0.5173
11.03.15	24	18	1	3.5	1.5	89.58	75	10000	8270	82.70	0.5556	0.7848
12.03.15	24	14	1	4	5	75	58.33	10000	6593	65.93	0.2884	0.6210
13.03.15	24	14	0	3	7	70.83	58.33	10000	7072	70.72	0.2922	0.6182
14.03.15	24	14	1	1.5	7.5	64.58	58.33	10000	6219	62.19	0.2343	0.5992
15.03.15	24	18	1	5	0	95.83	75	10000	8721	87.21	0.6268	0.7997
16.03.15	24	18	1	5	0	95.83	75	10000	7824	78.24	0.5624	0.7910
17.03.15	24	18	1	5	0	95.83	75	10000	7879	78.79	0.5663	0.7916
18.03.15	24	17	1	6	0	95.83	70.83	10000	8394	83.94	0.5698	0.7654
19.03.15	24	13	0	5	6	75	54.17	10000	6535	65.35	0.2655	0.5890
20.03.15	24	18	0	3.5	2.5	89.58	75	10000	6847	68.47	0.46	0.7701
21.03.15	24	16	1	4	3	83.33	66.67	10000	9120	91.20	0.5067	0.7193
22.03.15	24	14	1	2.5	6.5	68.75	58.33	10000	7717	77.17	0.3095	0.6199
23.03.15	24	14	0	7	3	87.5	58.33	10000	6270	62.70	0.32	0.6372
24.03.15	24	16	1	7	0	95.83	66.67	10000	7688	76.88	0.4912	0.7271
25.03.15	24	8	0	5	11	54.17	33.33	10000	4029	40.29	0.0727	0.3744
OVERALL	672	453	23	110	86	83.78	67.41	280000	230411	82.29	0.4647	0.7182

S/T= Scheduled Time, W/H= Working Hour, M/H= Maintenance Hour, I/H= Idle Hour, B/H= Breakdown Hour

3.3.1 Graphs on daily performance assessment of Surface miner L&T KSM 303(24) (a) January, (b) February, (c) March at Samaleswari OCP (from 26th Dec 2014 to 25th Mar 2015) have been presented in Figs.

1) Availability graphs

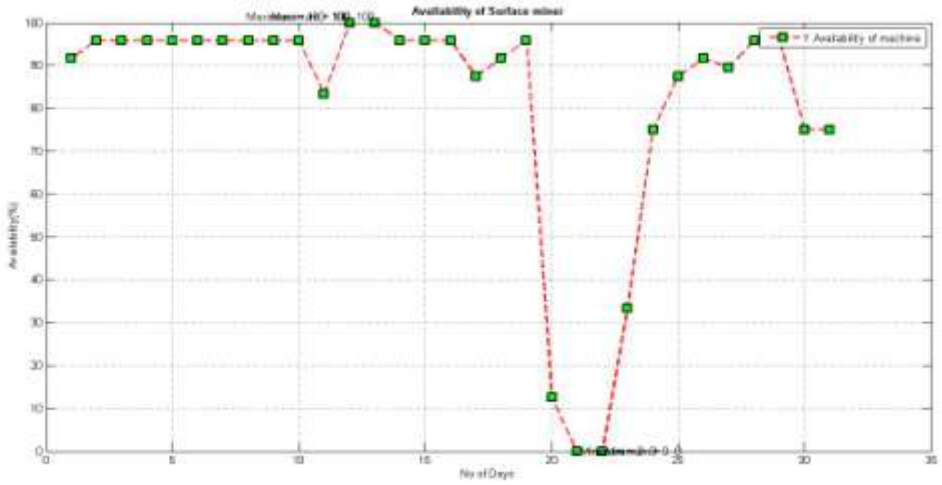

Figure 3.8 (a) Availability of L&T KSM 303(24) in January

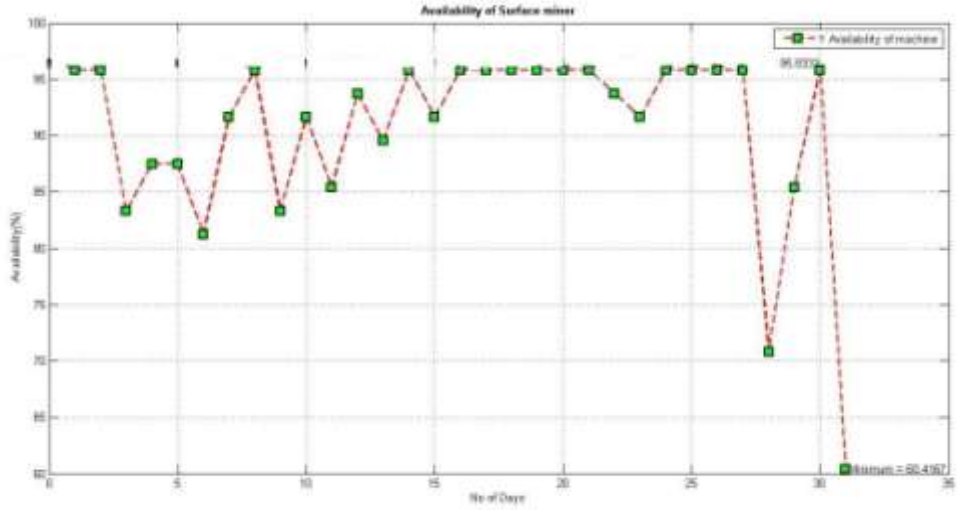

Figure 3.8 (b) Availability of L&T KSM 303(24) in February

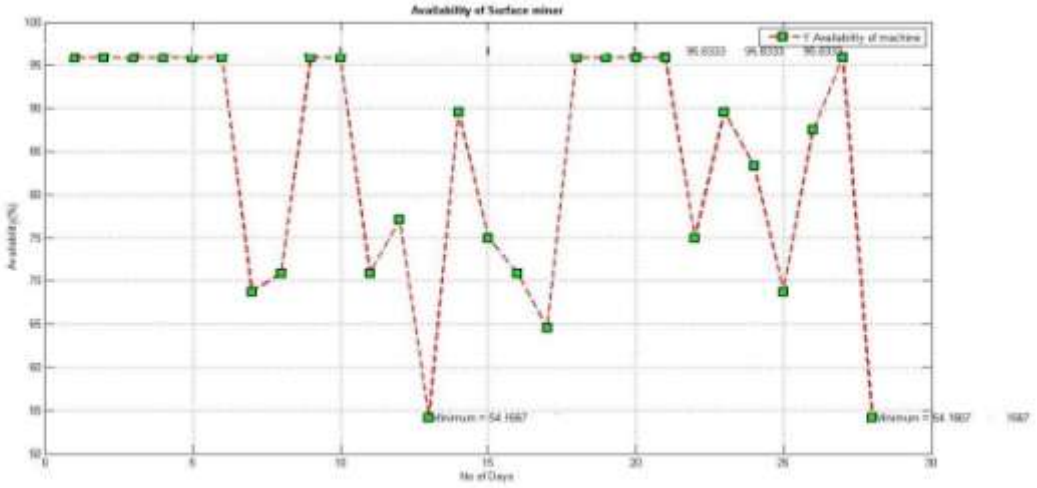

Figure 3.8 (c) Availability of L&T KSM 303(24) in March

2) Utilisation graphs

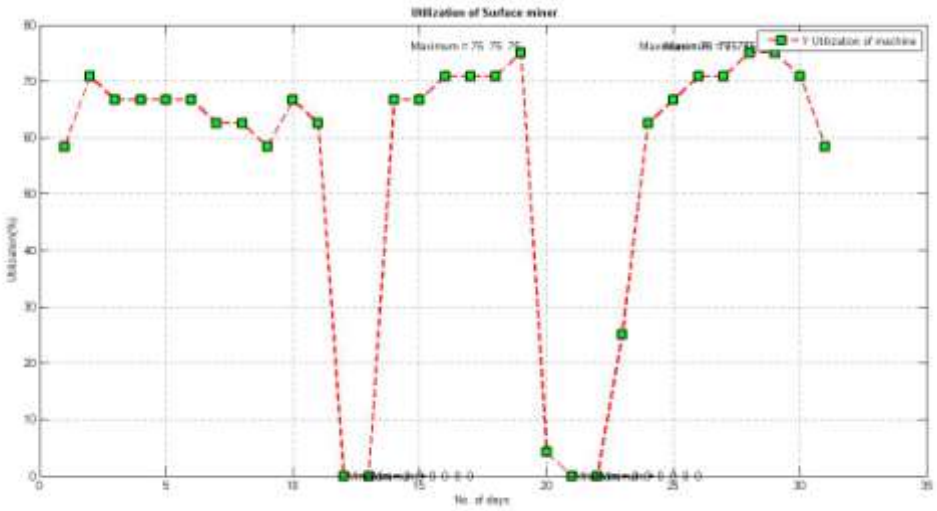

Figure 3.9 (a) Utilisation of L&T KSM 303(24) in January

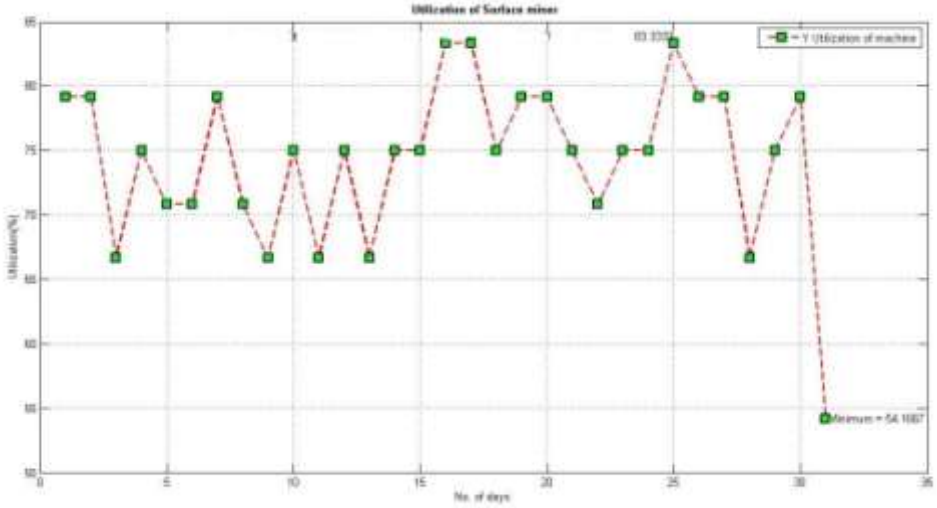

Figure 3.9 (b) Utilisation of L&T KSM 303(24) in February

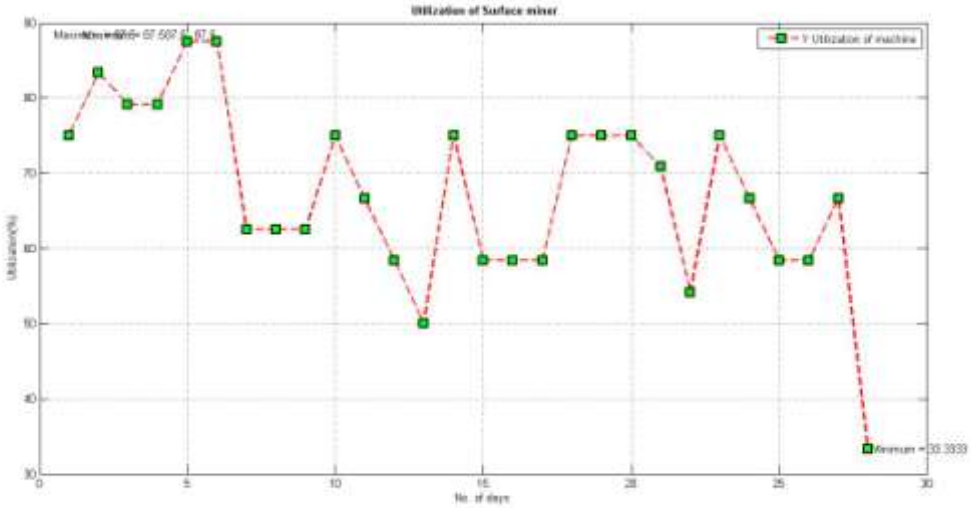

Figure 3.9 (c) Utilisation of L&T KSM 303(24) in March

3) Performance rate graphs

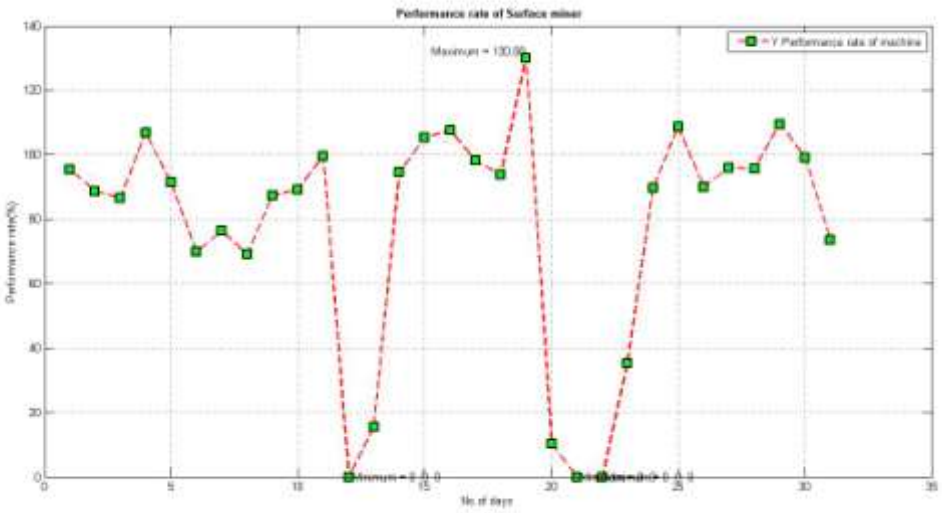

Figure 3.10 (a) Performance rate of L&T KSM 303(24) in January

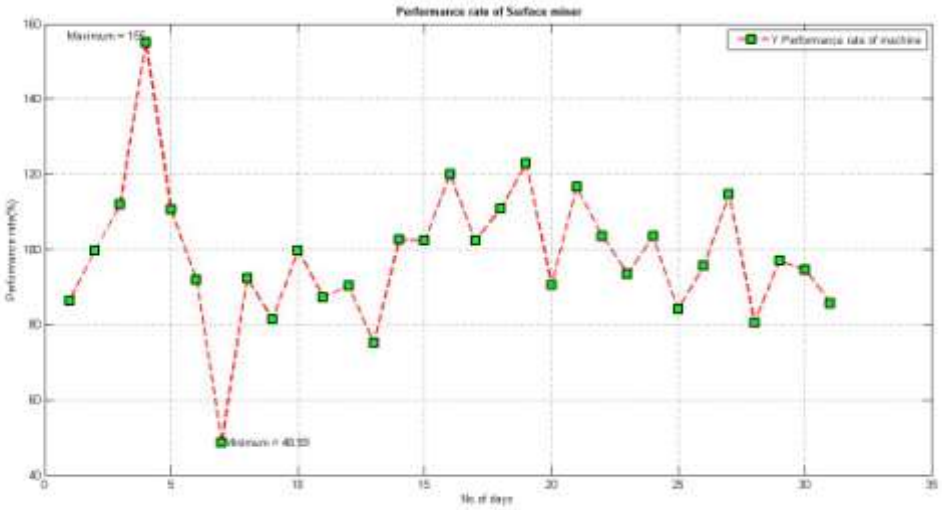

Figure 3.10 (b) Performance rate of L&T KSM 303(24) in February

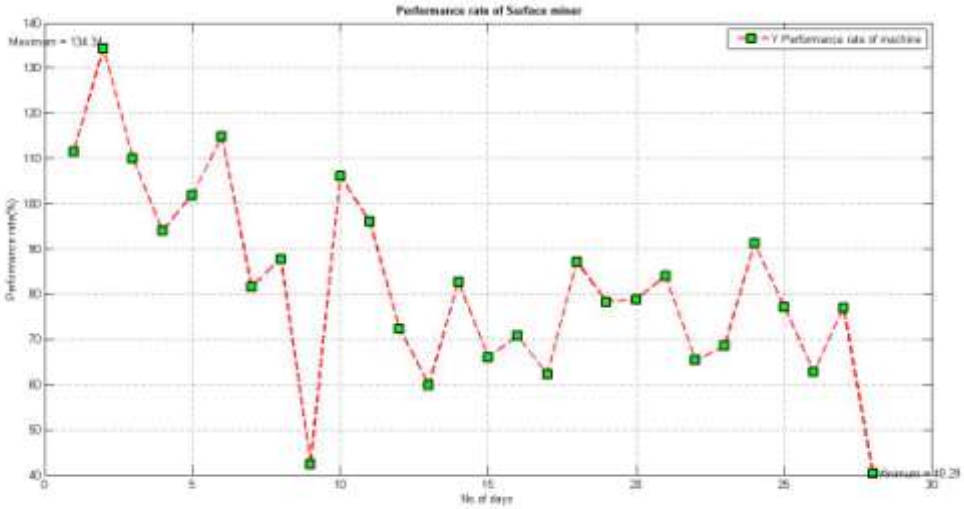

Figure 3.10 (c) Performance rate of L&T KSM 303(24) in March

4) Theoretical OEE and Estimated OEE graphs

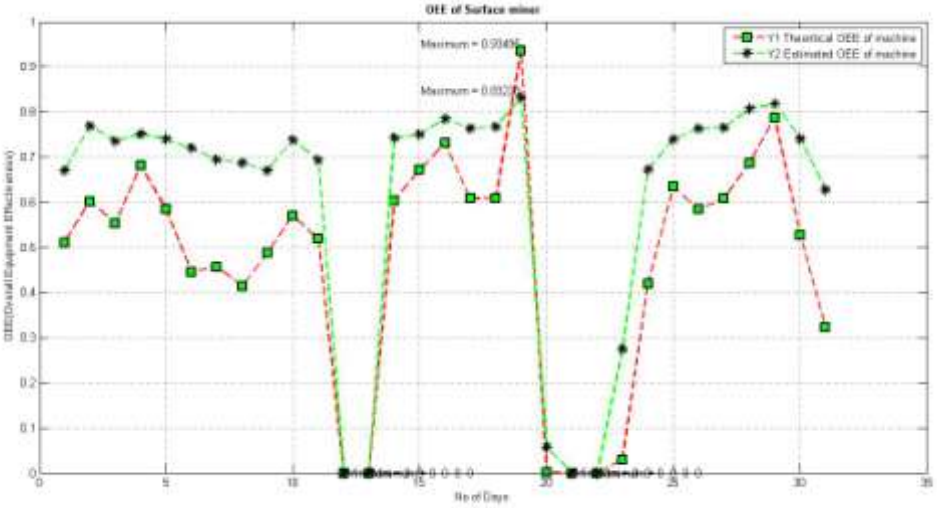

Figure 3.11(a) Theoretical OEE and Estimated OEE of L&T KSM 303(24) in January

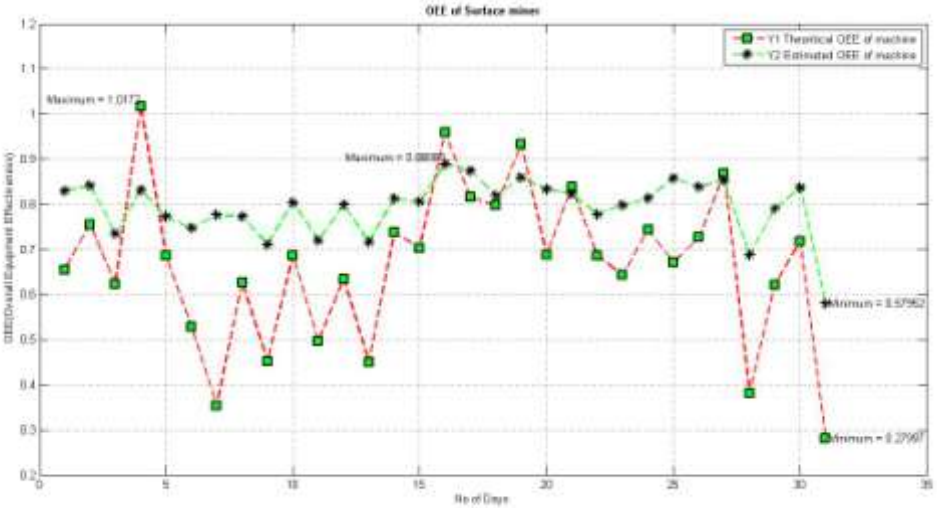

Figure 3.11(b) Theoretical OEE and Estimated OEE of L&T KSM 303(24) in February

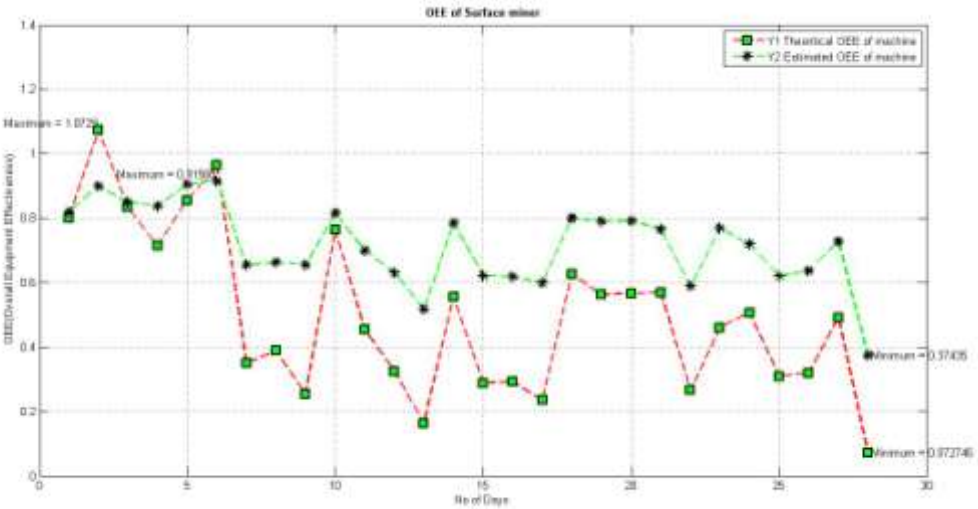

Figure 3.11(c) Theoretical OEE and Estimated OEE of L&T KSM 303(24) in March

5) Achieved Production graphs

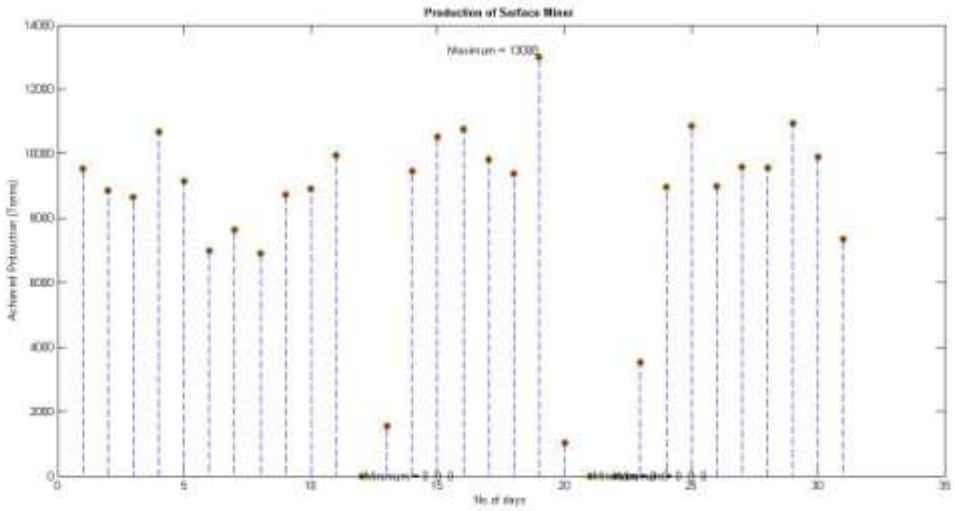

Figure 3.12 (a) Achieved Production of L&T KSM 303(24) in January

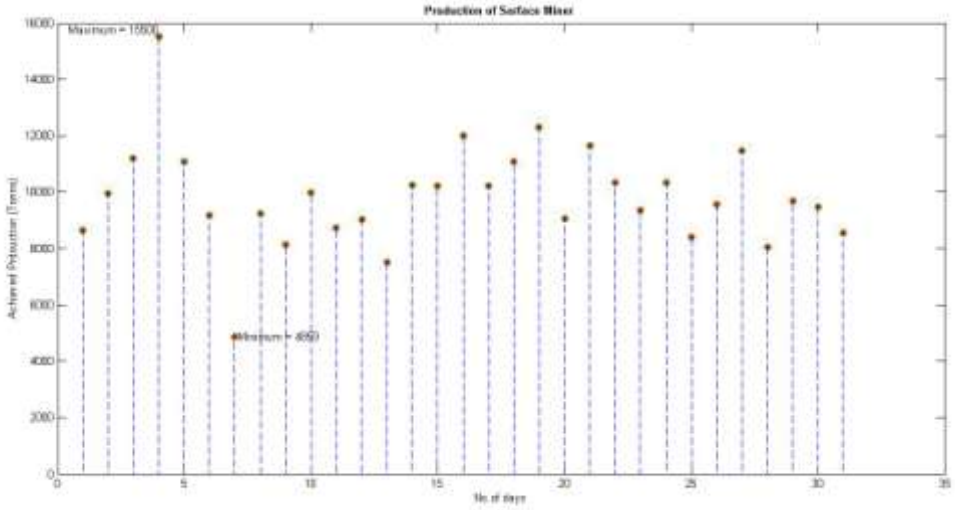

Figure 3.12 (b) Achieved Production of L&T KSM 303(24) in February

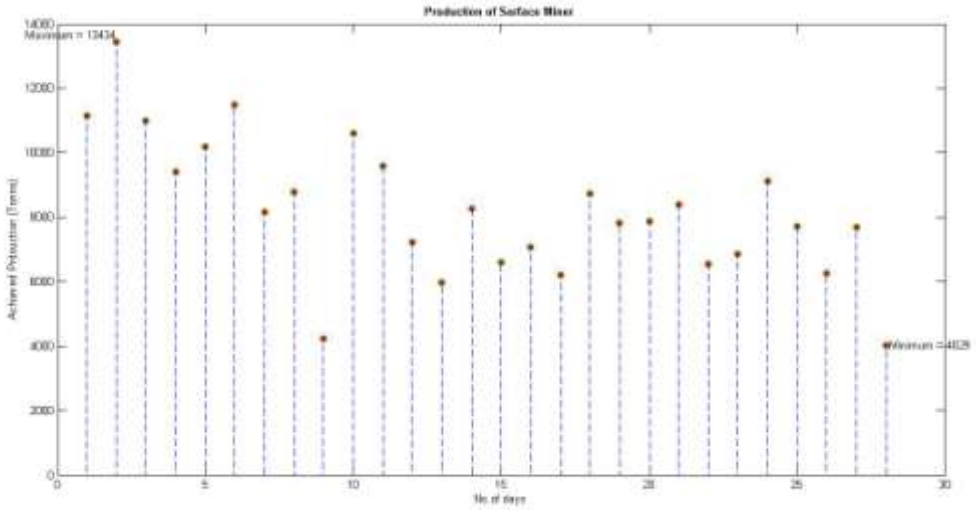

Figure 3.12 (c) Achieved Production of L&T KSM 303(24) in March

6) Breakdown hours graphs

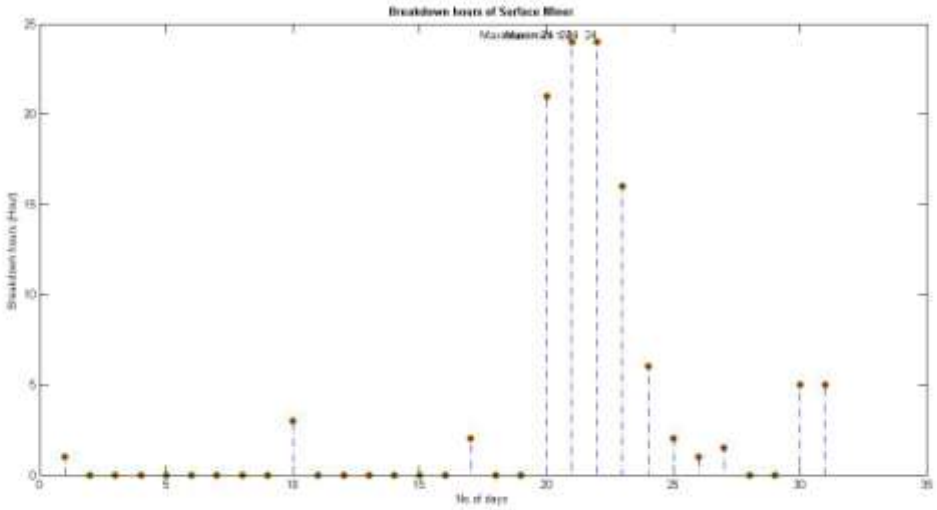

Figure 3.13 (a) Breakdown hours of L&T KSM 303(24) in January

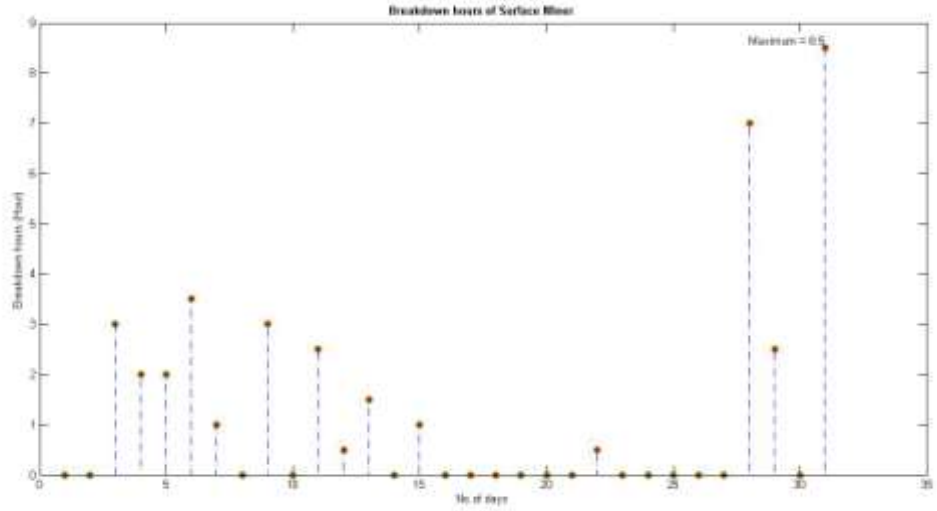

Figure 3.13 (b) Breakdown hours of L&T KSM 303(24) in February

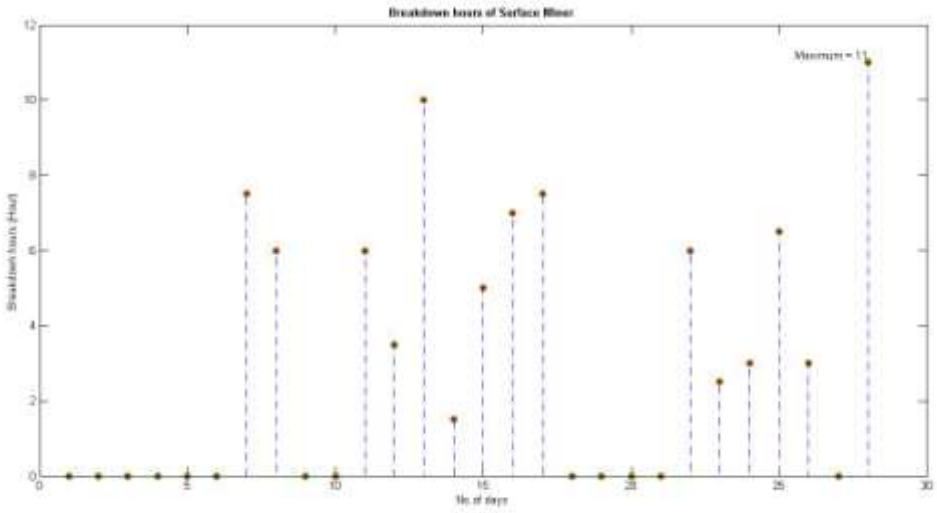

Figure 3.13 (c) Breakdown hours of L&T KSM 303(24) in March

7) Idle hour graphs

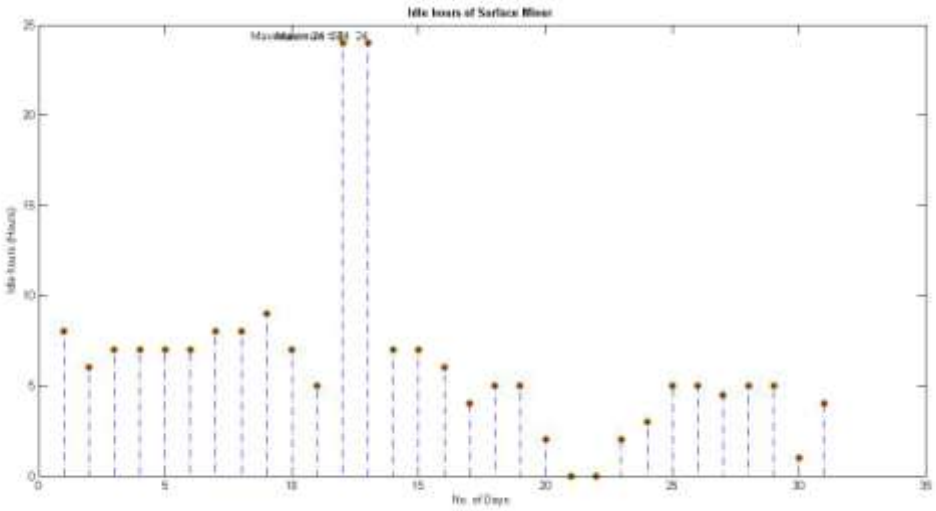

Figure 3.14(a) Idle hour of L&T KSM 303(24) in January

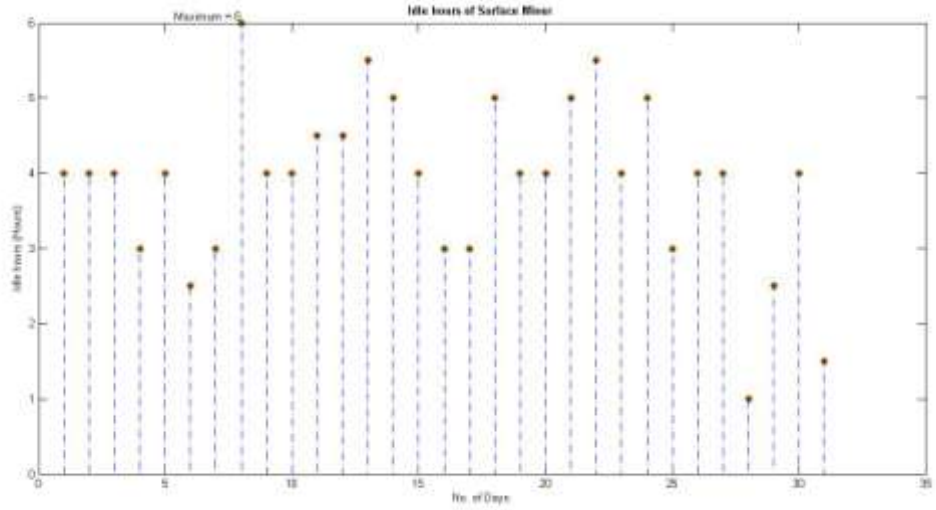

Figure 3.14(b) Idle hour of L&T KSM 303(24) in February

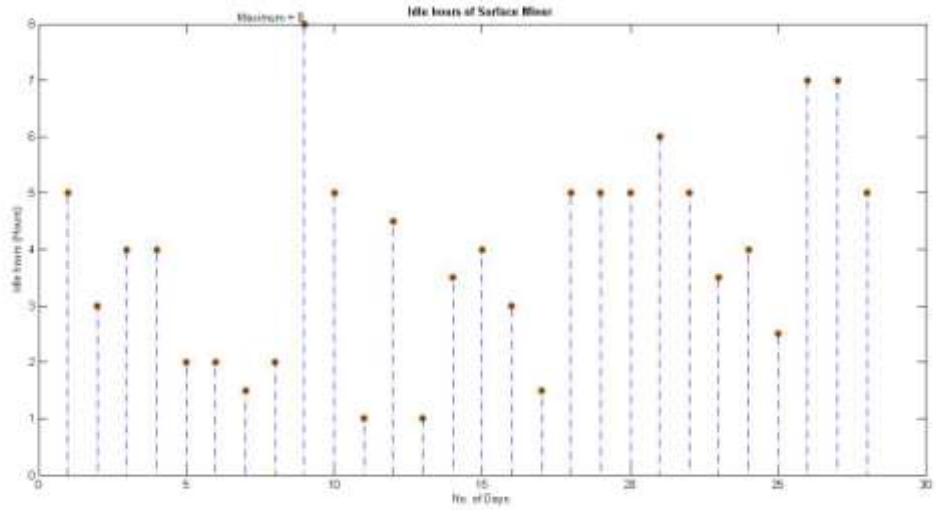

Figure 3.14(c) Idle hour of L&T KSM 303(24) in March

3.4 MONTHLY PERFORMANCE OF SURFACE MINER L&T KSM-303(15) IN LAKHANPUR OCP

Table 3.11: Performance of Surface miner (L&T-303(15)) at Lakhanpur OCP (Year 2013)

MONTH	S/T	W/H	M/H	I/H	B/H	Availability	Utilisation	Target Production(T)	Achieved Production(T)	Performance rate	Theoretical OEE	Estimated OEE
Dec-12	433	279	34	89	31	84.99	64.43	135312.5	154479	114.16	0.63	0.79
Jan-13	670	305	29	258	78	84.03	45.52	209375	194607	92.95	0.36	0.63
Feb-13	670	418	33	163.5	55.5	86.79	62.39	209375	277087	132.34	0.72	0.80
Mar-13	630	431	27.5	118	53.5	87.14	68.41	196875	223521	113.53	0.68	0.81
Apr-13	592	366	23	141.5	61.5	85.73	61.82	185000	177052.3	95.70	0.51	0.74
May-13	0	0	0	0	0	0.00	0.00	0	0	0.00	0.00	0.00
Jun-13	660	192	25	320.5	122.5	77.65	29.09	206250	38987.73	18.90	0.04	0.36
Jul-13	412	96	11	291	14	93.93	23.30	128750	48428	37.61	0.08	0.39
Aug-13	670	255	18	80	317	50	38.06	209375	149572	71.44	0.14	0.47
Sep-13	346	202	19	108	17	89.60	58.38	108125	96906	89.62	0.47	0.72
Oct-13	14	5	1	8	0	92.86	35.71	4375	3917	89.53	0.30	0.57
Nov-13	670	337	38.5	272.5	22	90.97	50.30	209375	182323	87.08	0.40	0.67

Table 3.12: Performance of Surface miner (L&T-303(15)) at Lakhanpur OCP (Year-2014)

MONTH	S/T	W/H	M/H	I/H	B/H	Availability	Utilisation	Target Production(T)	Achieved Production(T)	Performance rate	Theoretical OEE	Estimated OEE
Dec-13	650	335	30	269	16	92.92	51.54	203125	170445.6	83.91	0.40	0.68
Jan-14	670	311	37	304	18	91.79	46.42	209375	157121	75.04	0.32	0.63
Feb-14	654	262	25	176	191	66.97	40.06	204375	119055	58.25	0.16	0.50
Mar-14	0	0	0	0	0	0.00	0.00	0	0	0.00	0.00	0.00
Apr-14	670	247	35	367	21	91.64	36.87	209375	142128	67.88	0.23	0.55
May-14	650	278	28	237	107	79.23	42.77	203125	147146	72.44	0.25	0.57
Jun-14	670	319	32	315	4	94.63	47.61	209375	176143	84.13	0.38	0.66
Jul-14	650	289	32	277	52	87.08	44.46	203125	191660	94.36	0.37	0.63
Aug-14	670	191	28	449	2	95.52	28.51	209375	115025	54.94	0.15	0.47
Sep-14	670	321	35	296	18	92.09	47.91	209375	202476.7	96.71	0.43	0.67
Oct-14	650	242	28	300	80	83.38	37.23	203125	149232	73.47	0.23	0.54
Nov-14	670	366	34	262	8	93.73	54.63	209375	220249	105.19	0.54	0.73

S/T= Scheduled Time, W/H= Working Hour, M/H= Maintenance Hour, I/H= Idle Hour, B/H= Breakdown Hours

Table 3.13: Performance of Surface miner (L&T-303(15)) at Lakhanpur OCP (Year-2015)

MONTH	S/T	W/H	M/H	I/H	B/H	Availability	Utilisation	Target Production(T)	Achieved Production(T)	Performance rate	Theoretical OEE	Estimated OEE
Dec-14	650	295	26	119	210	63.69	45.38	203125	174049	85.69	0.25	0.57
Jan-15	670	340	32	219	79	83.43	50.75	209375	162440	77.58	0.33	0.64
Feb-15	670	345	34	228	63	85.52	51.49	209375	197668	94.41	0.42	0.68
Mar-15	630	328	33	239	30	90.00	52.06	196875	175264	89.02	0.42	0.68

S/T= Scheduled Time, W/H= Working Hour, M/H= Maintenance Hour, I/H= Idle Hour, B/H= Breakdown Hour

3.4.1 Graphs on monthly performance assessment of Surface miner L&T KSM-303(15) from (a) Dec-2012 to Nov-2013 (b) Dec-2013 to Nov-2014 (c) Dec-2014 to Mar-2015 at Lakhanpur OCP have been presented in Figs.

1) Availability graphs

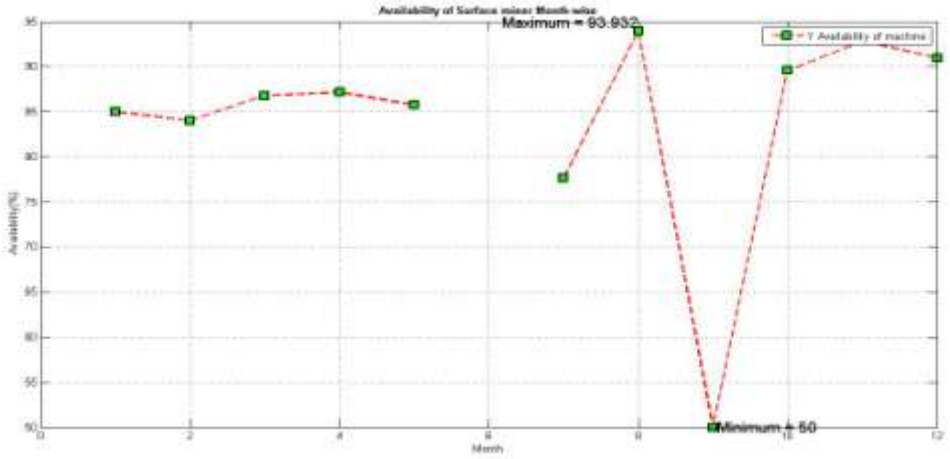

Figure 3.15 (a) Availability of L&T KSM-303(15) from Dec-2012 to Nov-2013

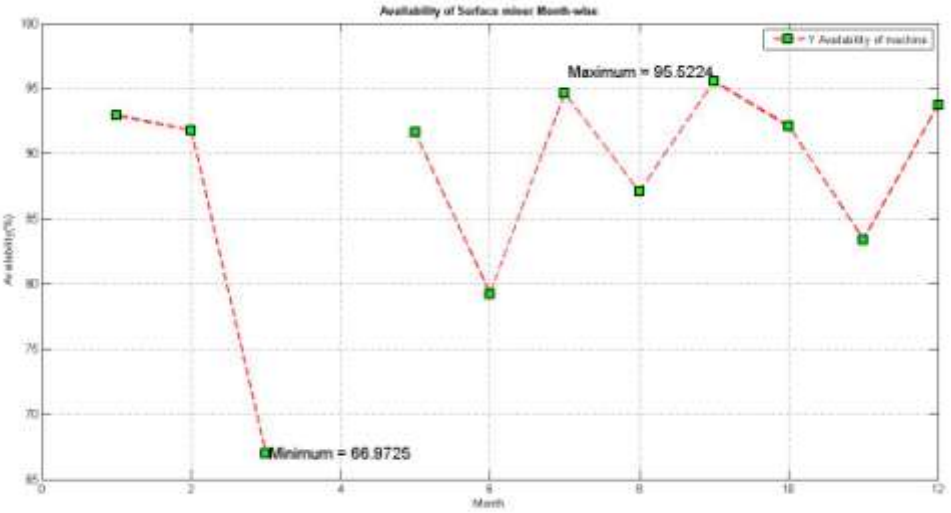

Figure 3.15 (b) Availability of L&T KSM-303(15) from Dec-2013 to Nov-2014

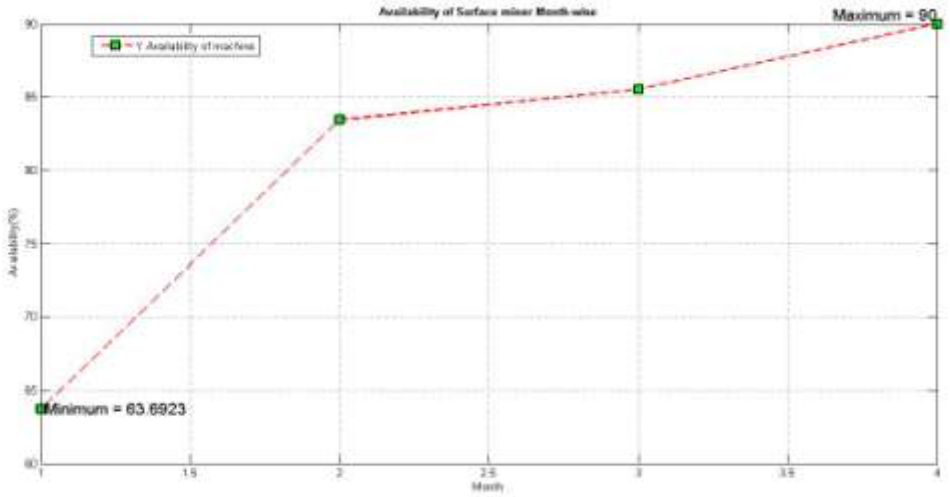

Figure 3.15 (c) Availability of L&T KSM-303(15) from Dec-2014 to Mar-2015

2) Utilisation graphs

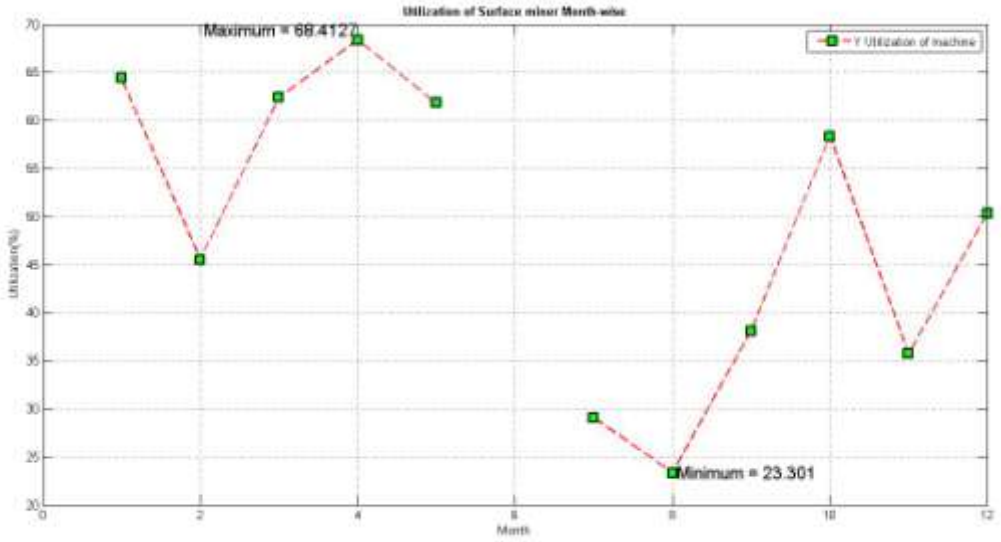

Figure 3.16 (a) Utilisation of L&T KSM-303(15) from Dec-2012 to Nov-2013

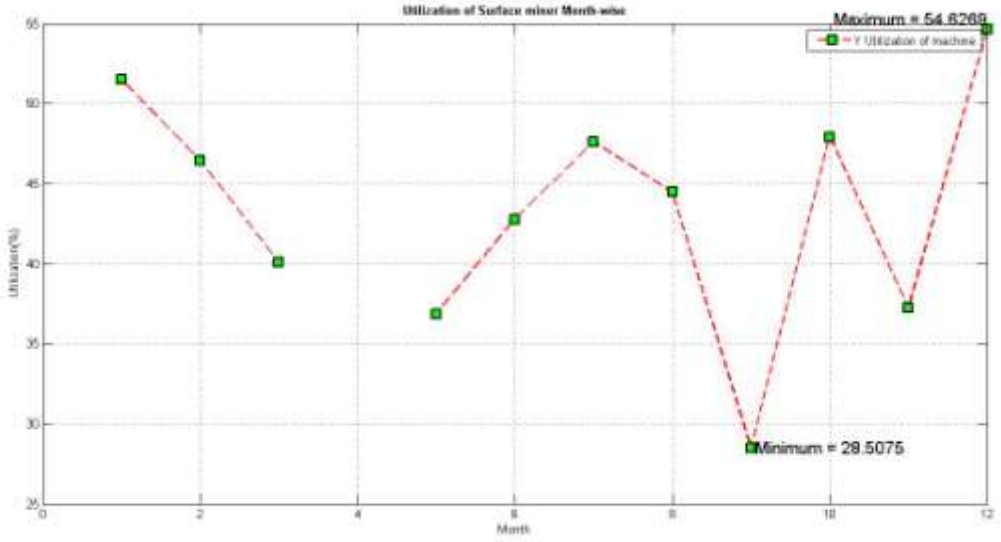

Figure 3.16 (b) Utilisation of L&T KSM-303(15) from Dec-2013 to Nov-2014

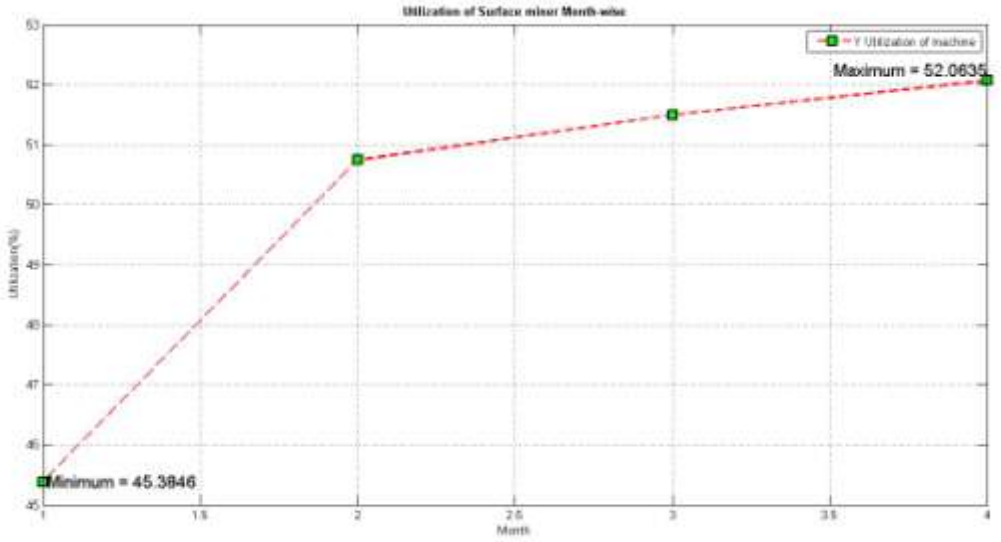

Figure 3.16 (c) Utilisation of L&T KSM-303(15) from Dec-2014 to Mar-2015

3) Performance rate graphs

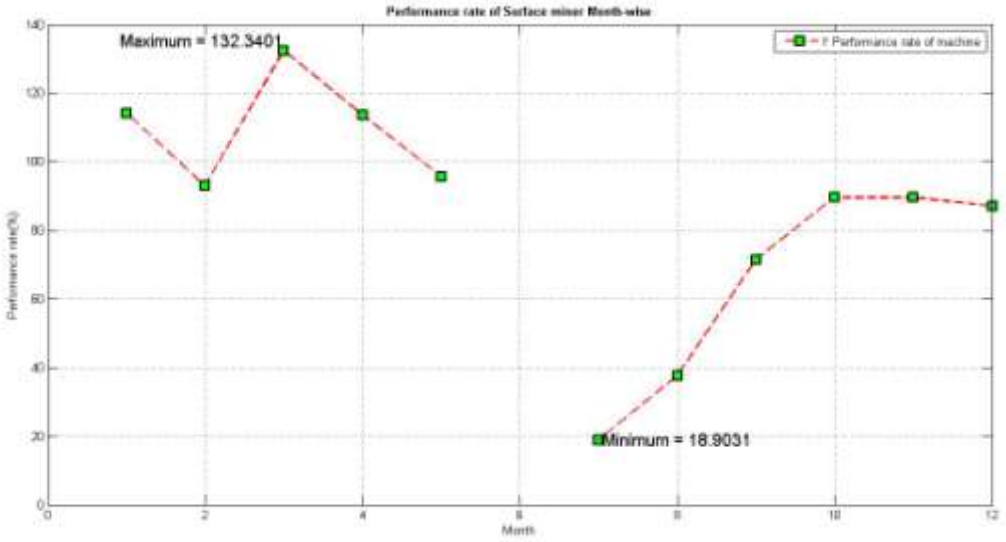

Figure 3.17 (a) Performance rate of L&T KSM-303(15) from Dec-2012 to Nov-2013

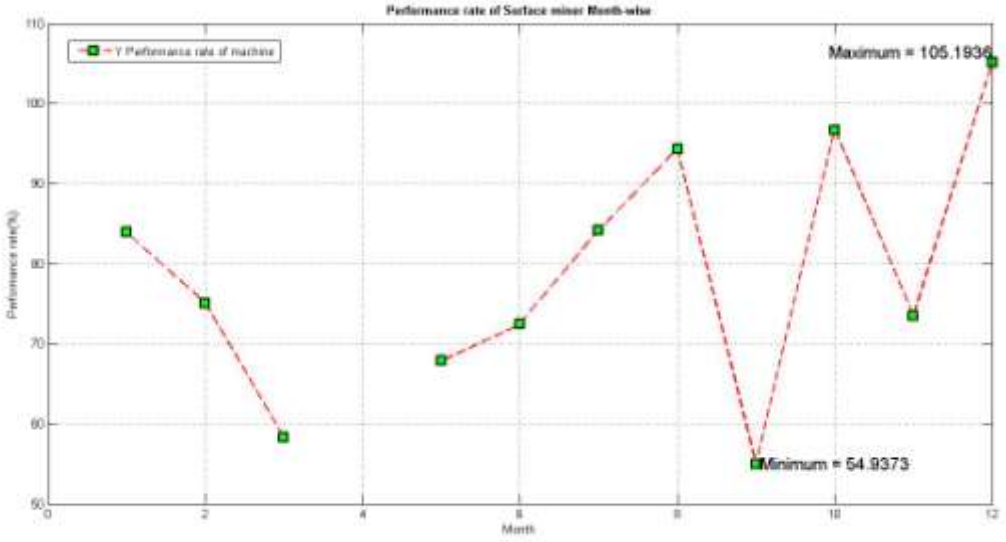

Figure 3.17 (b) Performance rate of L&T KSM-303(15) from Dec-2013 to Nov-2014

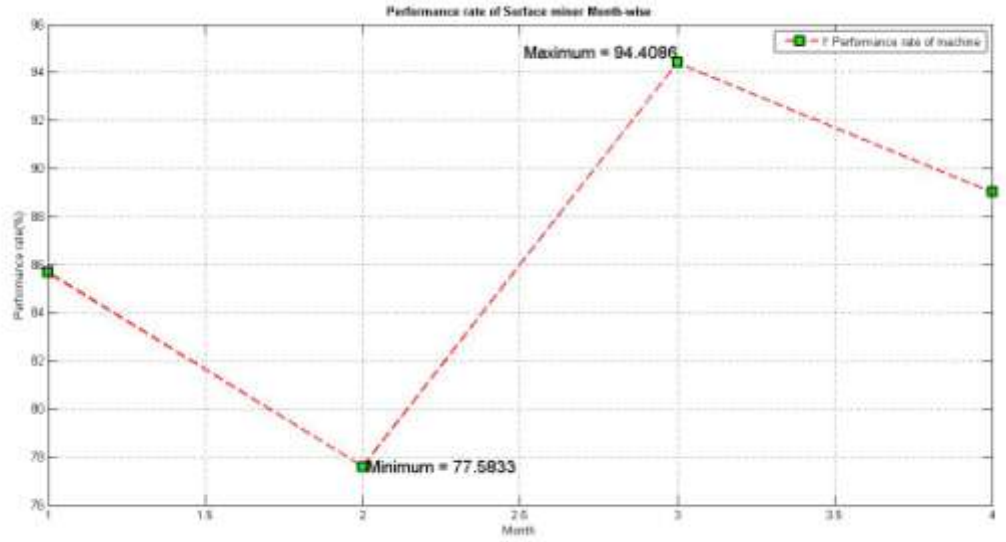

Figure 3.17 (c) Performance rate of L&T KSM-303(15) from Dec-2014 to Mar-2015

4) Theoretical OEE and Estimated OEE graphs

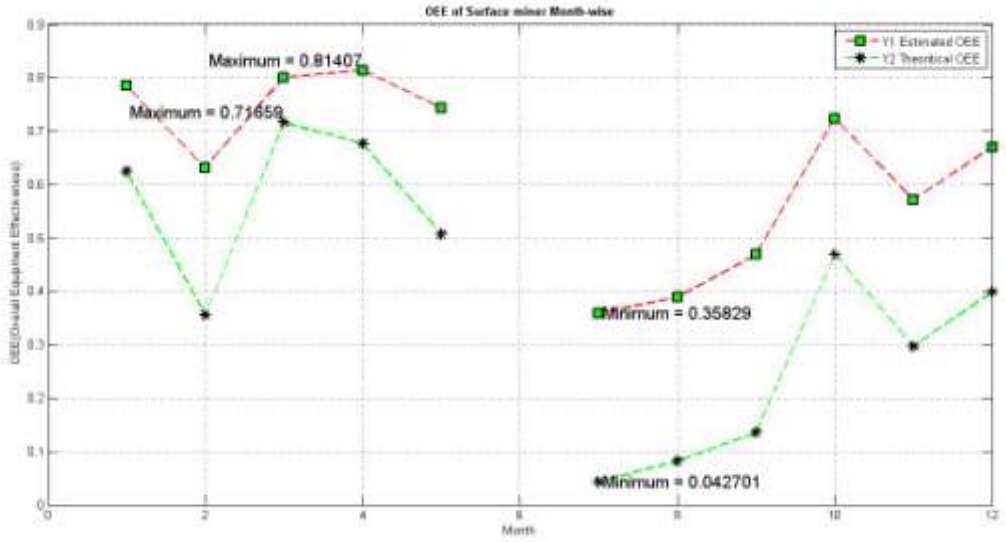

Figure 3.18 (a) Theoretical OEE and Estimated OEE of L&T KSM-303(15) from Dec-2012 to Nov-2013

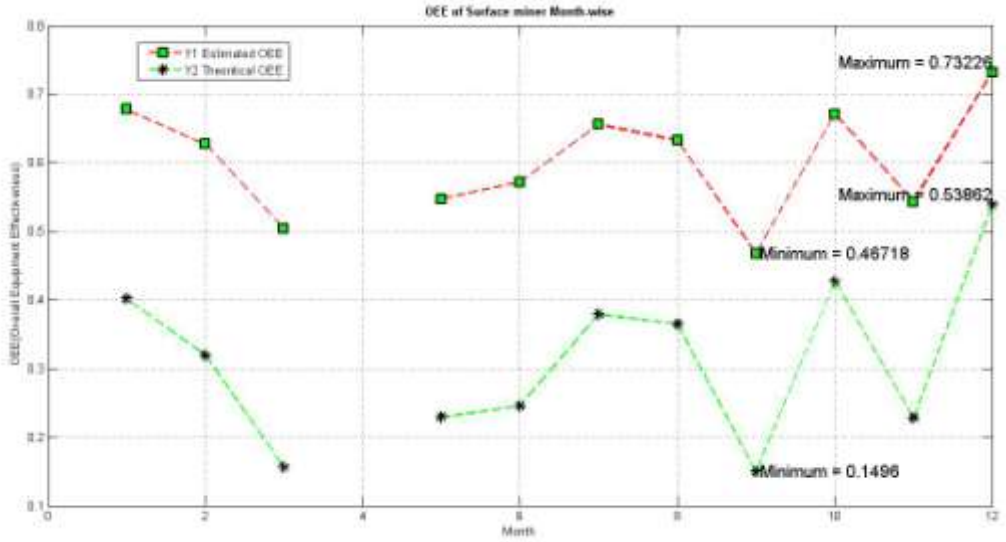

Figure 3.18 (b) Theoretical OEE and Estimated OEE of L&T KSM-303(15) from Dec-2013 to Nov-2014

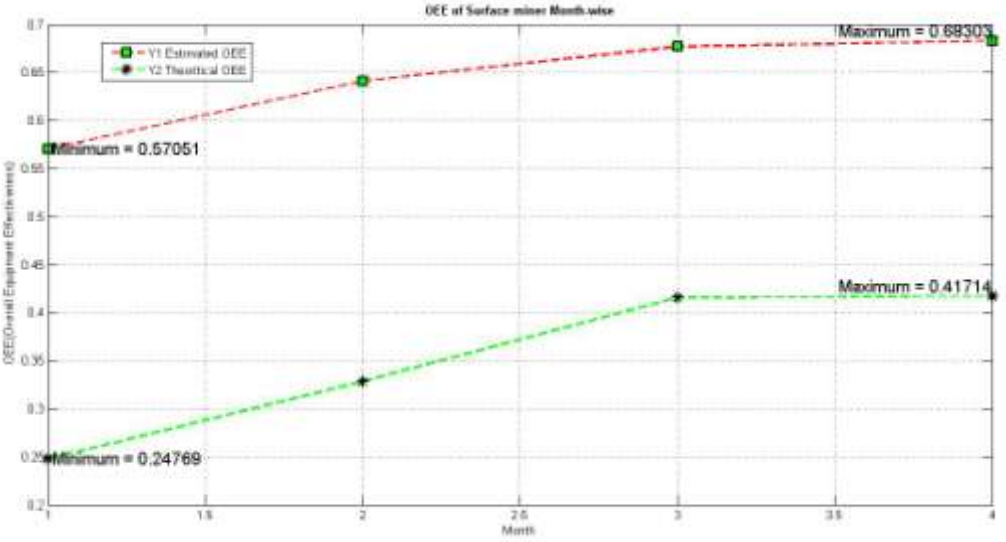

Figure 3.18 (c) Theoretical OEE and Estimated OEE of L&T KSM-303(15) from Dec-2014 to Mar-2015

5) Achieved production graphs

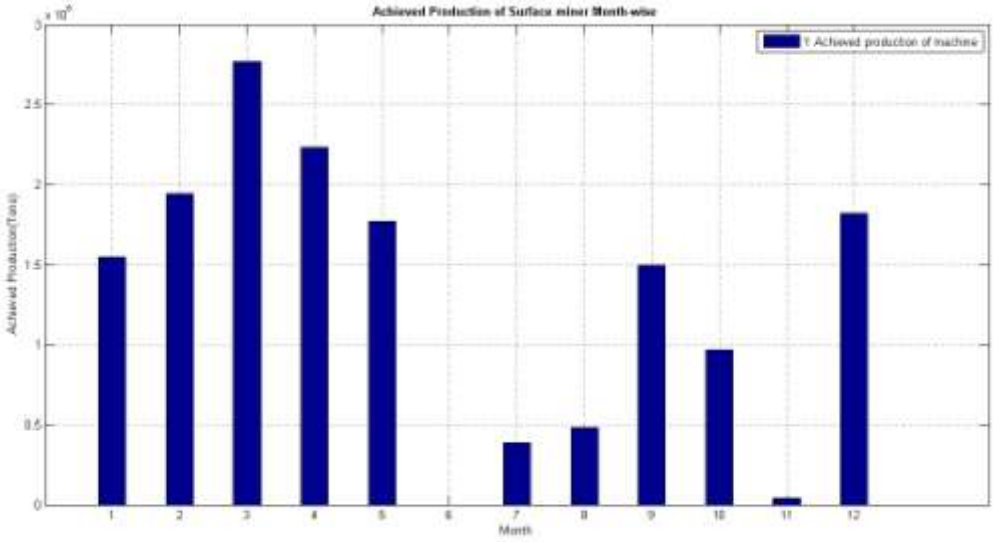

Figure 3.19 (a) Achieved production of L&T KSM-303(15) from Dec-2012 to Nov-2013

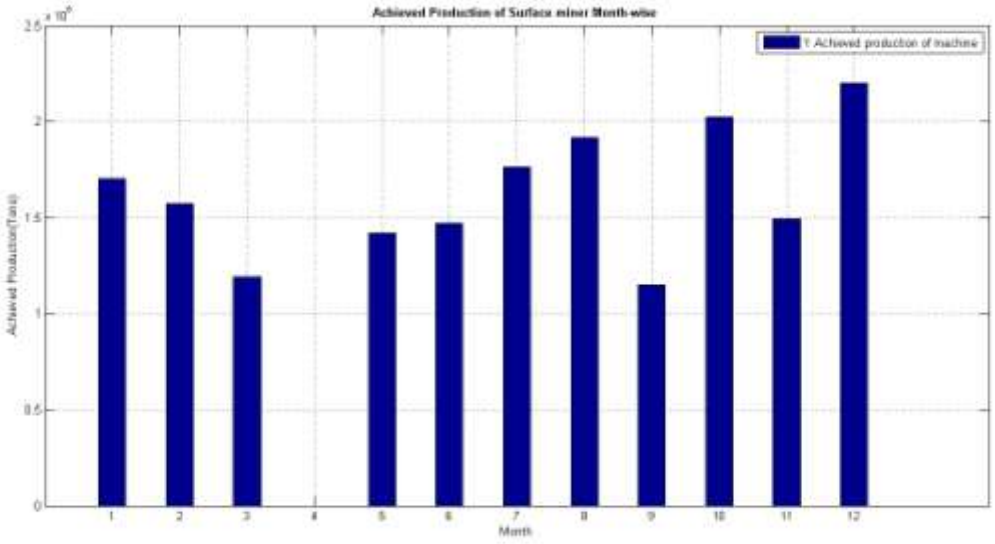

Figure 3.19 (b) Achieved production of L&T KSM-303(15) from Dec-2013 to Nov-2014

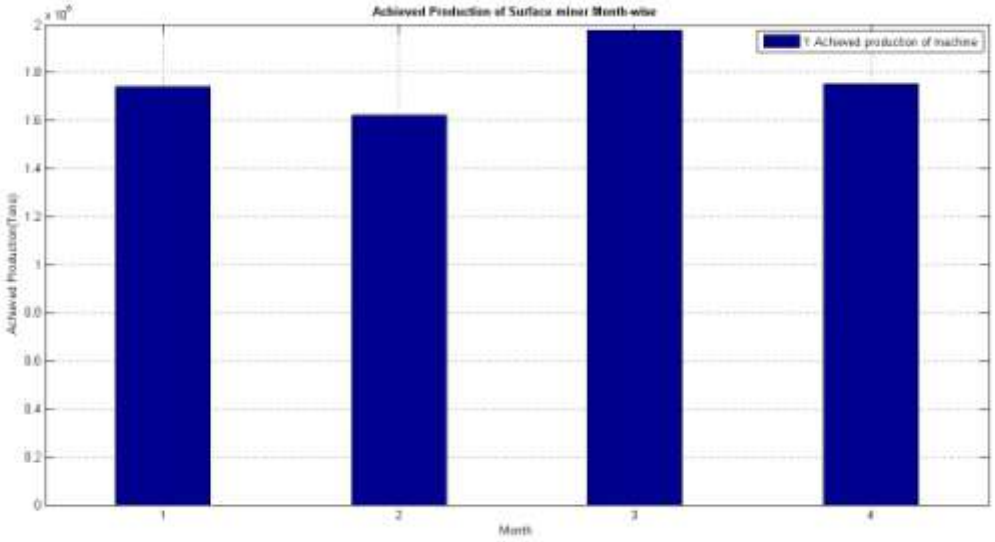

Figure 3.19 (c) Achieved production of L&T KSM-303(15) from Dec-2014 to Mar-2015

6) Breakdown Hours graphs

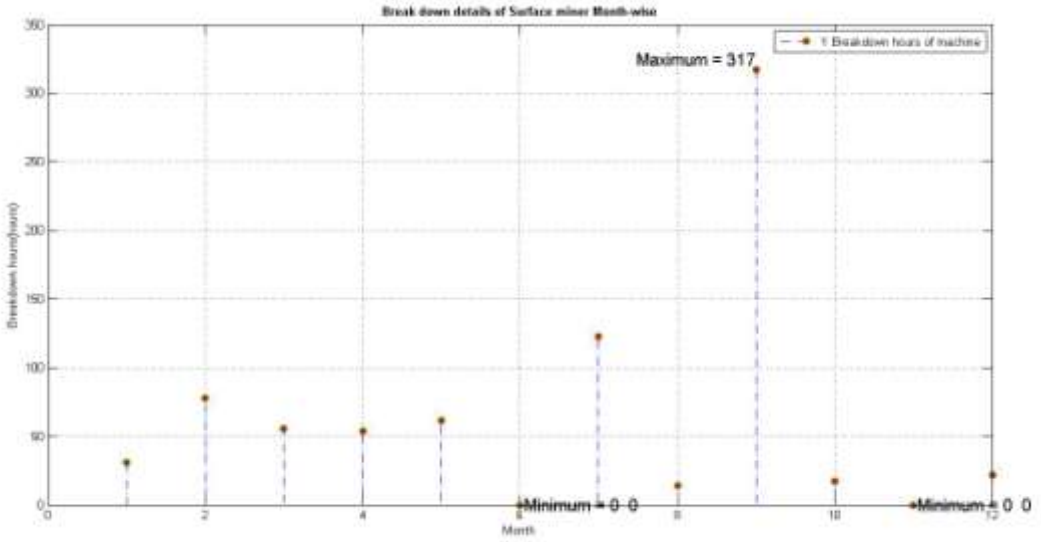

Figure 3.20 (a) Breakdown Hours of L&T KSM-303(15) from Dec-2012 to Nov-2013

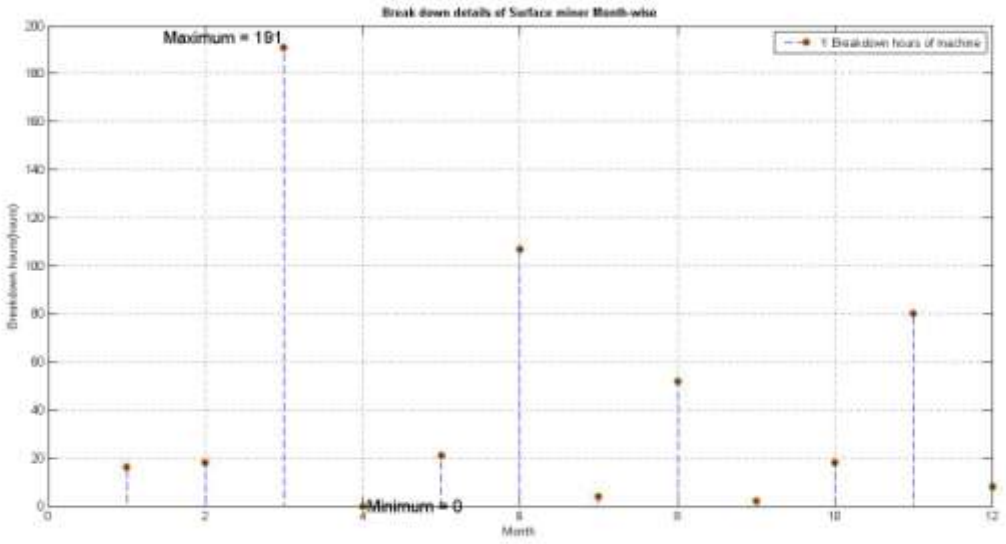

Figure 3.20 (b) Breakdown Hours of L&T KSM-303(15) from Dec-2013 to Nov-2014

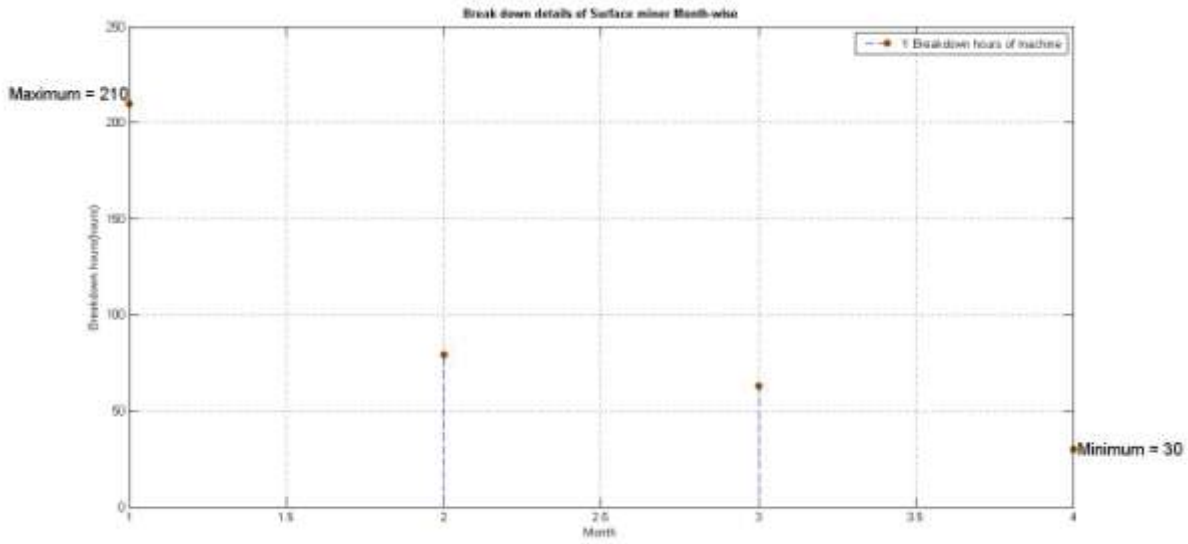

Figure 3.20 (c) Breakdown Hours of L&T KSM-303(15) from Dec-2014 to Mar-2015

7) Idle hours graphs

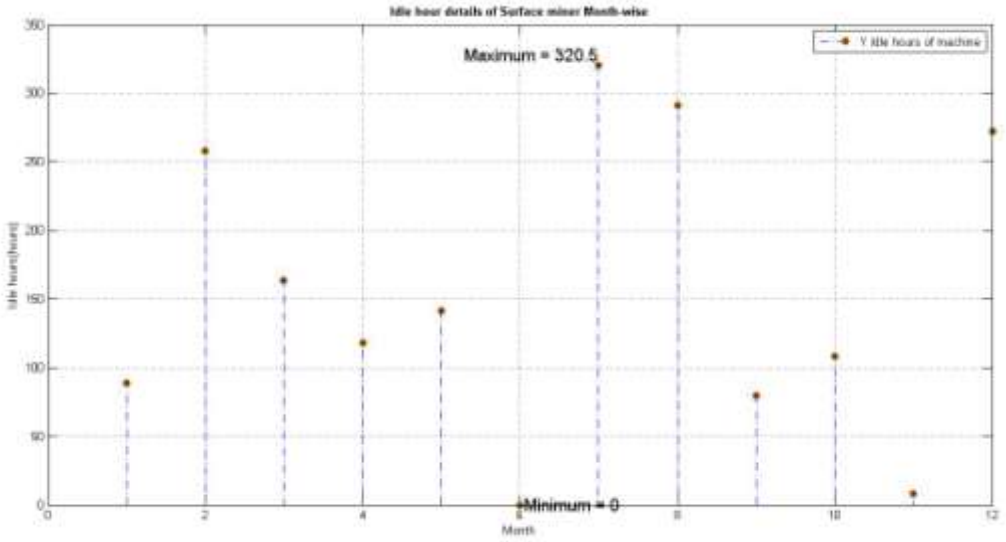

Figure 3.21 (a) Idle hours of L&T KSM-303(15) from Dec-2012 to Nov-2013

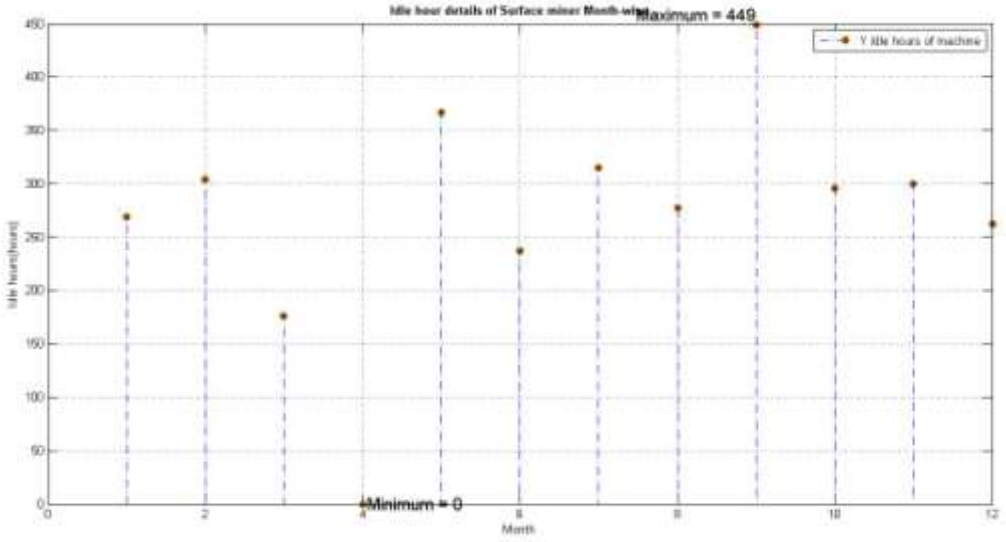

Figure 3.21 (b) Idle hours of L&T KSM-303(15) from Dec-2013 to Nov-2014

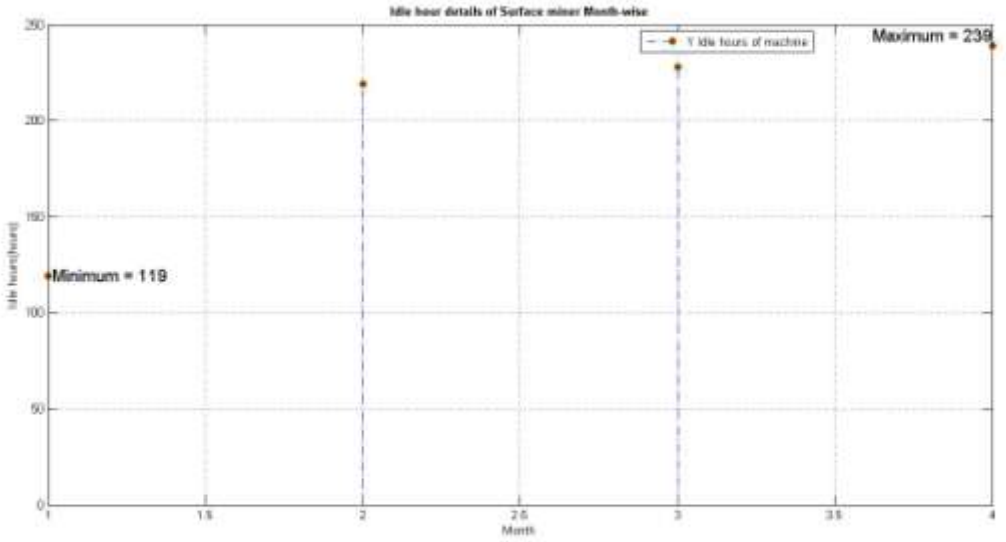

Figure 3.21 (c) Idle hours of L&T KSM-303(15) from Dec-2014 to Mar-2015

3.5 MONTHLY PERFORMANCE OF SURFACE MINER L&T KSM-303(21) IN LAKHANPUR OCP

Table 3.14: Performance of Surface miner (L&T-303(21)) at Lakhanpur OCP (Year 2013-15)

MONTH	S/T	W/H	M/H	I/H	B/H	Availability	Utilisation	Target Production(T)	Achieved Production(T)	Performance rate	Theoretical OEE	Estimated OEE
Sep-13	346	228	19	93	6	92.77	65.90	108125	118634.5	109.72	0.67	0.81
Oct-13	650	408	31	189.5	21.5	91.92	62.77	203125	232825.2	114.62	0.66	0.79
Nov-13	670	409	33	213	15	92.84	61.04	209375	225624.85	107.76	0.61	0.78
Dec-13	650	372	34	237	7	93.69	57.23	203125	177525	87.40	0.47	0.72
Jan-14	670	346	33	291	0	95.07	51.64	209375	145875	69.67	0.34	0.66
Feb-14	670	490	32	135	13	93.28	73.13	209375	310023	148.07	1.01	0.91
Mar-14	630	97	15	451	67	86.98	15.40	196875	46426	23.58	0.03	0.28
Apr-14	670	354	34	275	7	93.88	52.84	209375	230050	109.87	0.55	0.73
May-14	650	461	34	149	6	93.85	70.92	203125	245933	121.07	0.81	0.86
Jun-14	670	412	37	213	8	93.28	61.49	209375	237748.8	113.55	0.65	0.79
Jul-14	650	395	31	216	8	94.00	60.77	203125	267686	131.78	0.75	0.81
Aug-14	670	329	34	278	29	90.60	49.10	209375	237240.1	113.31	0.50	0.70
Sep-14	670	452	35	150	33	89.85	67.46	209375	267972	127.99	0.78	0.84
Oct-14	650	410	32	150	58	86.15	63.08	203125	249106	122.64	0.67	0.79
Nov-14	670	390	32	209	39	89.40	58.21	209375	203409	97.15	0.51	0.73
Dec-14	650	445	29	132	44	88.77	68.46	203125	280016	137.85	0.84	0.85
Jan-15	670	396	32	217	25	91.49	59.10	209375	257246	122.86	0.66	0.78
Feb-15	670	443	35	179	13	92.84	66.12	209375	265714	126.91	0.78	0.83
Mar-15	630	365	35	207	23	90.79	57.94	196875	208388	105.85	0.56	0.75

S/T= Scheduled Time, W/H= Working Hour, M/H= Maintenance Hour, I/H= Idle Hour, B/H= Breakdown Hour

3.5.1 Graphs on monthly performance assessment of Surface miner L&T KSM-303(21) from (a) Sep-2013 to Nov-2014 (b) Dec-2014 to Mar-2014 at Lakhanpur OCP have been presented in Figs

1) Availability graphs

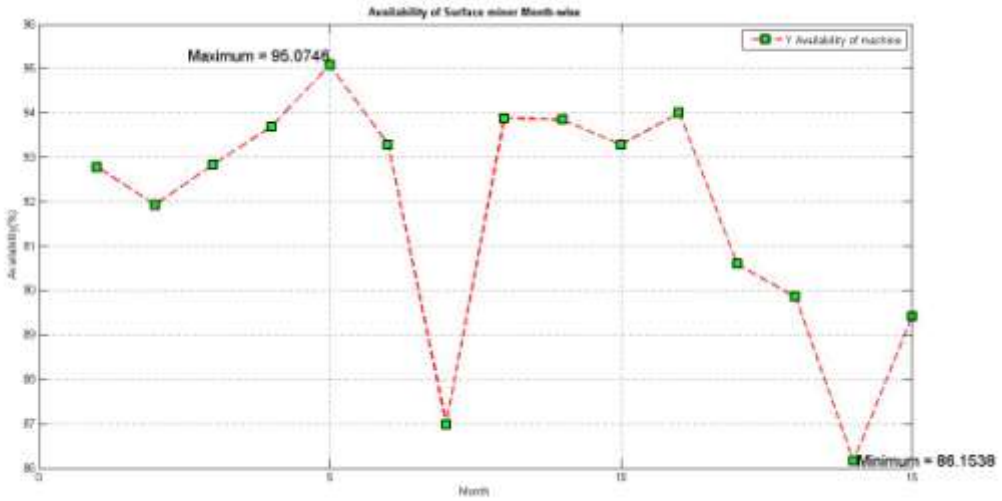

Figure 3.22 (a) Availability of L&T KSM-303(21) from Sep-2013 to Nov-2014

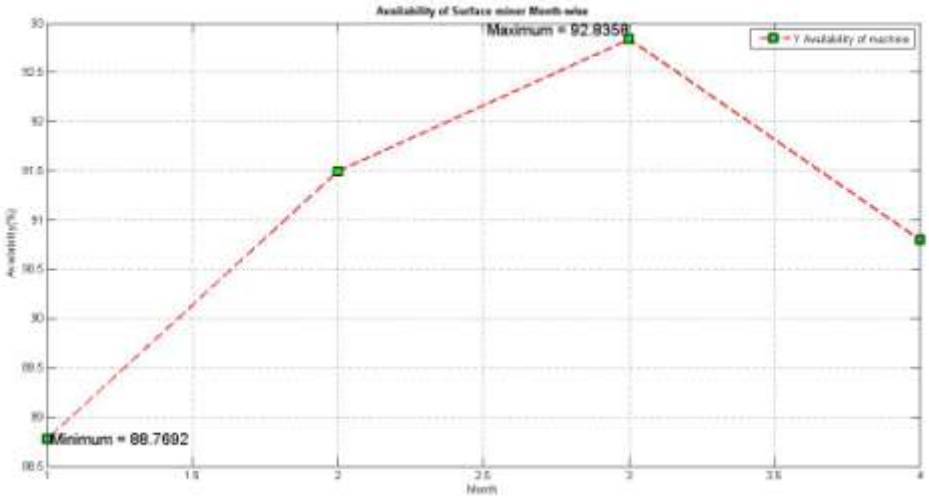

Figure 3.22 (b) Availability of L&T KSM-303(21) from Dec-2014 to Mar-2014

2) Utilisation graphs

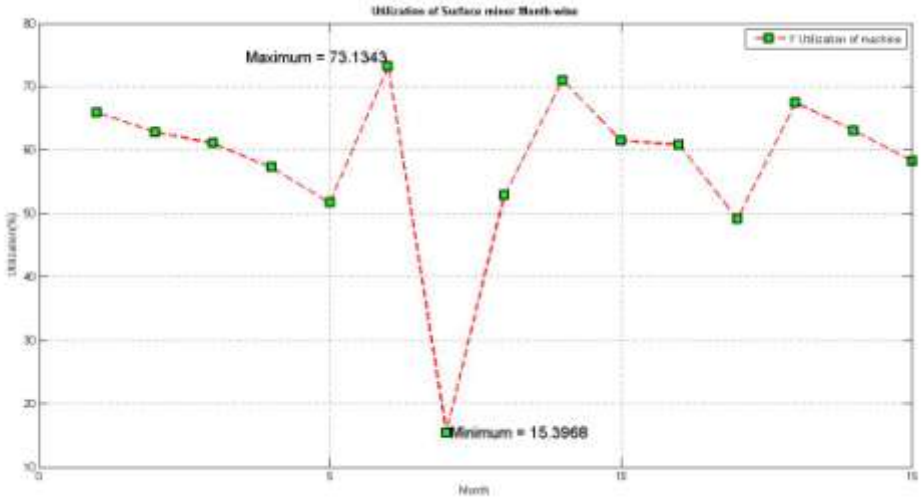

Figure 3.23 (a) Utilisation of L&T KSM-303(21) from Sep-2013 to Nov-2014

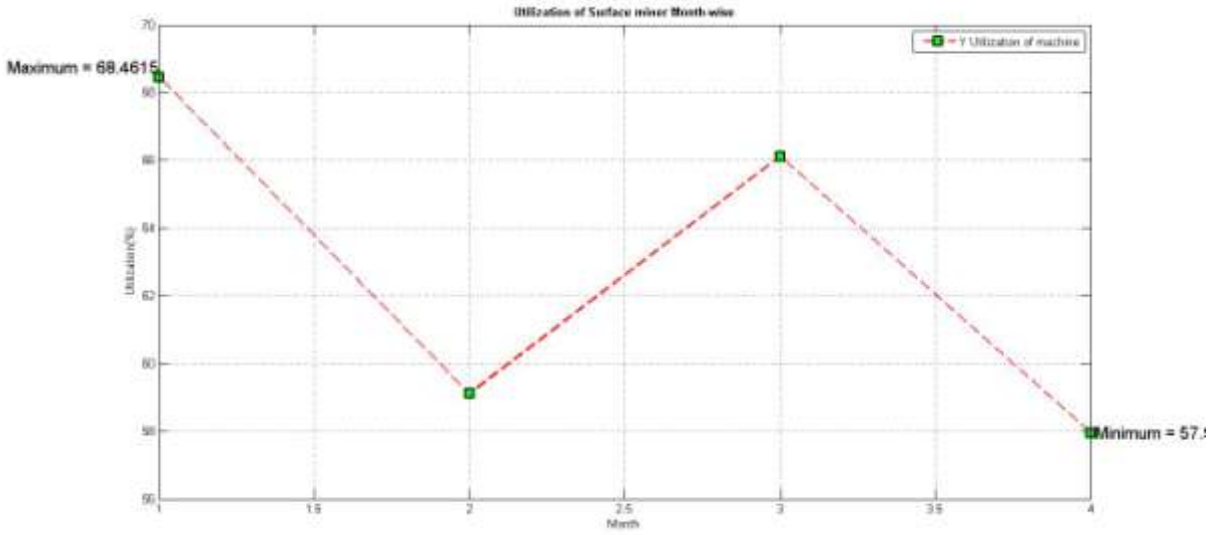

Figure 3.23 (b) Utilisation of L&T KSM-303(21) from Dec-2014 to Mar-2014

3) Performance rate graphs

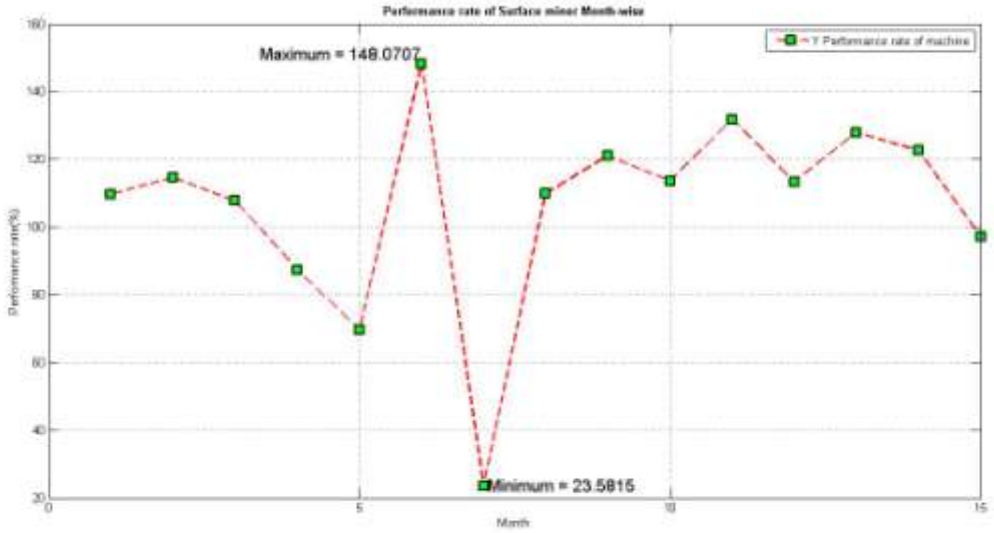

Figure 3.24 (a) Performance rate of L&T KSM-303(21) from Sep-2013 to Nov-2014

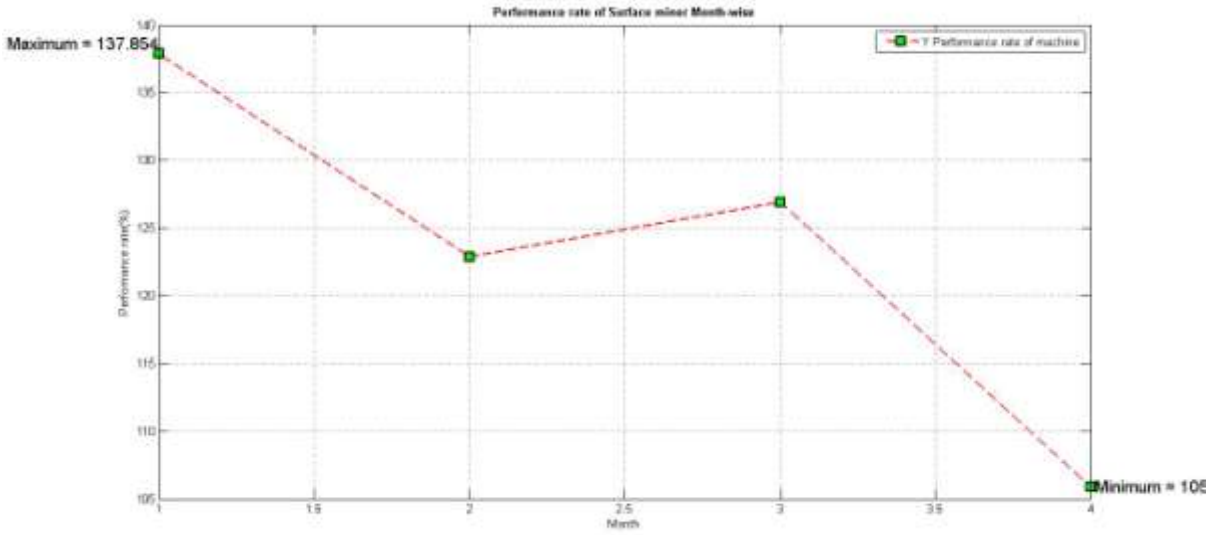

Figure 3.24 (b) Performance rate of L&T KSM-303(21) from Dec-2014 to Mar-2014

4) Theoretical OEE and Estimated OEE graphs

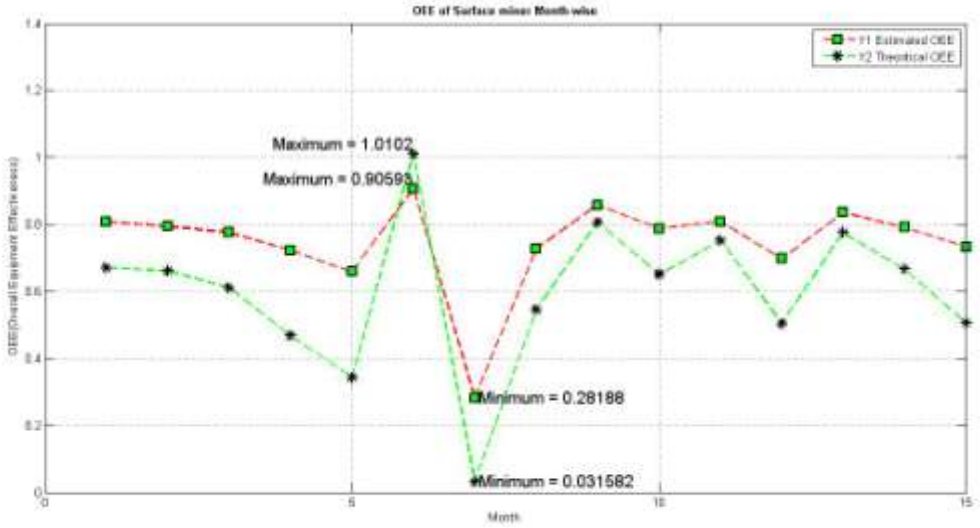

Figure 3.25 (a) Theoretical OEE and Estimated OEE of L&T KSM-303(21) from Sep-2013 to Nov-2014

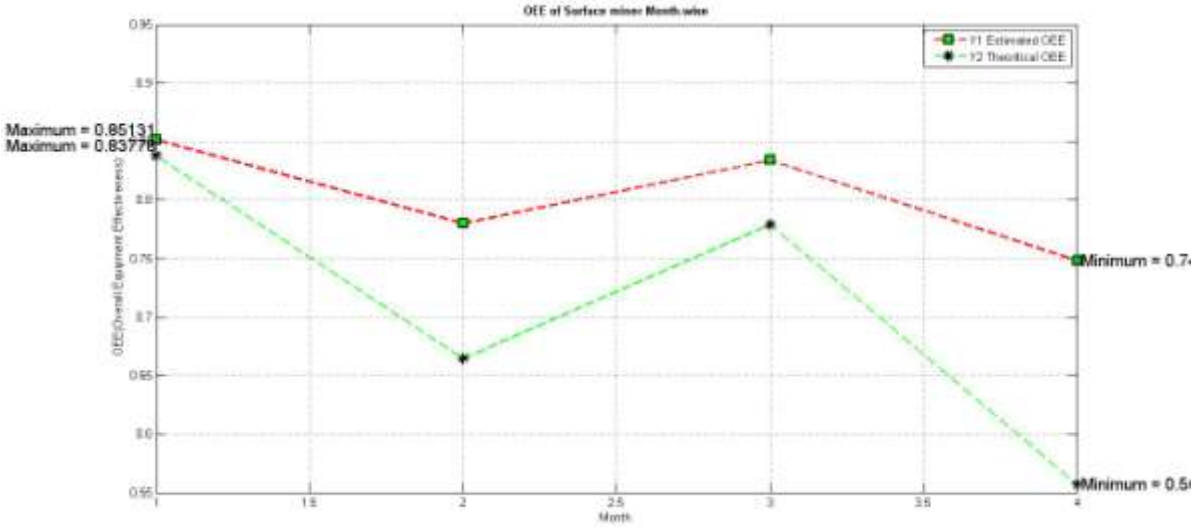

Figure 3.25 (b) Theoretical OEE and Estimated OEE of L&T KSM-303(21) from Dec-2014 to Mar-2014

5) Achieved production graphs

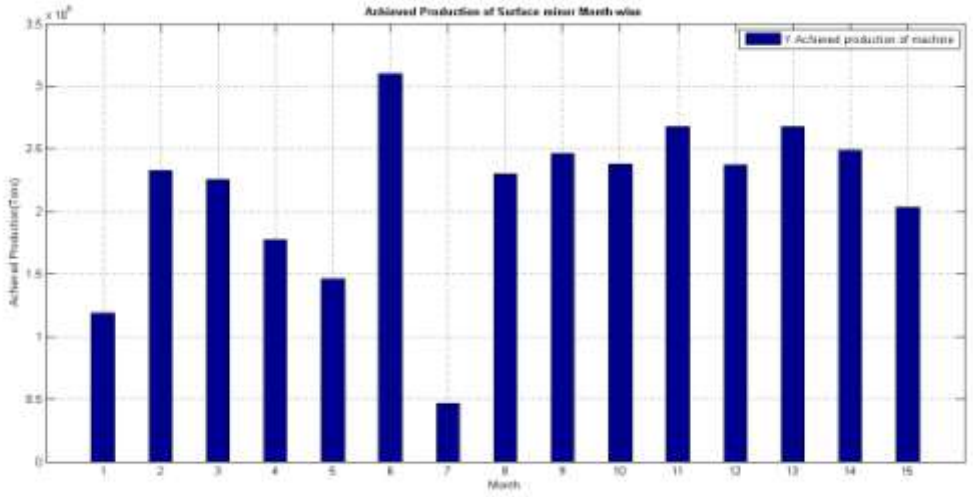

Figure 3.26 (a) Achieved production of L&T KSM-303(21) from Sep-2013 to Nov-2014

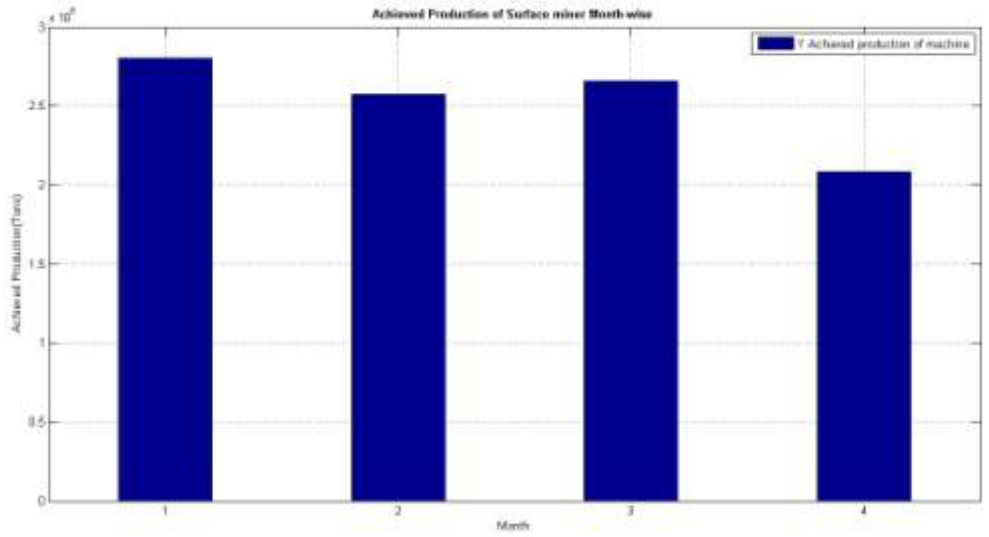

Figure 3.26 (b) Achieved production of L&T KSM-303(21) from Dec-2014 to Mar-2014

6) Breakdown hours graphs

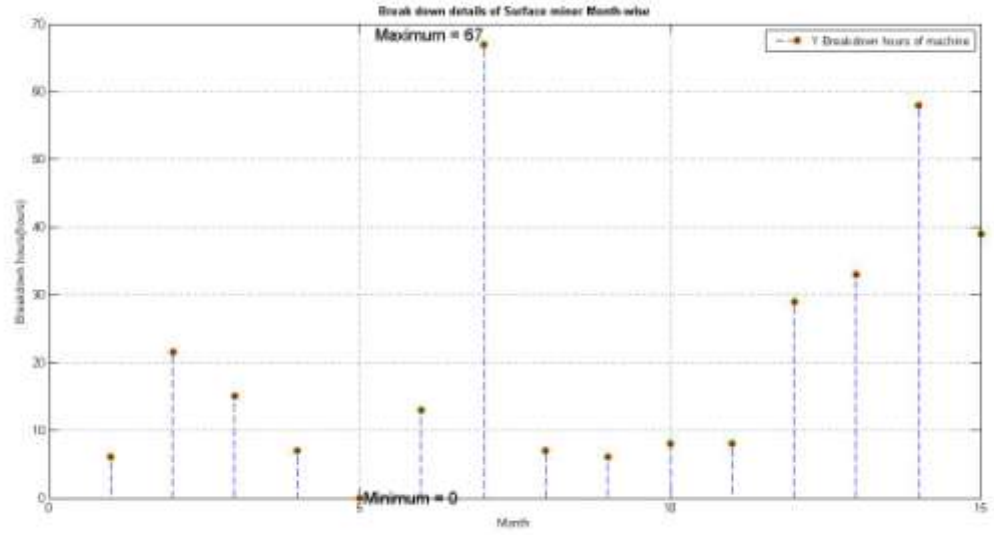

Figure 3.27 (a) Breakdown hours of L&T KSM-303(21) from Sep-2013 to Nov-2014

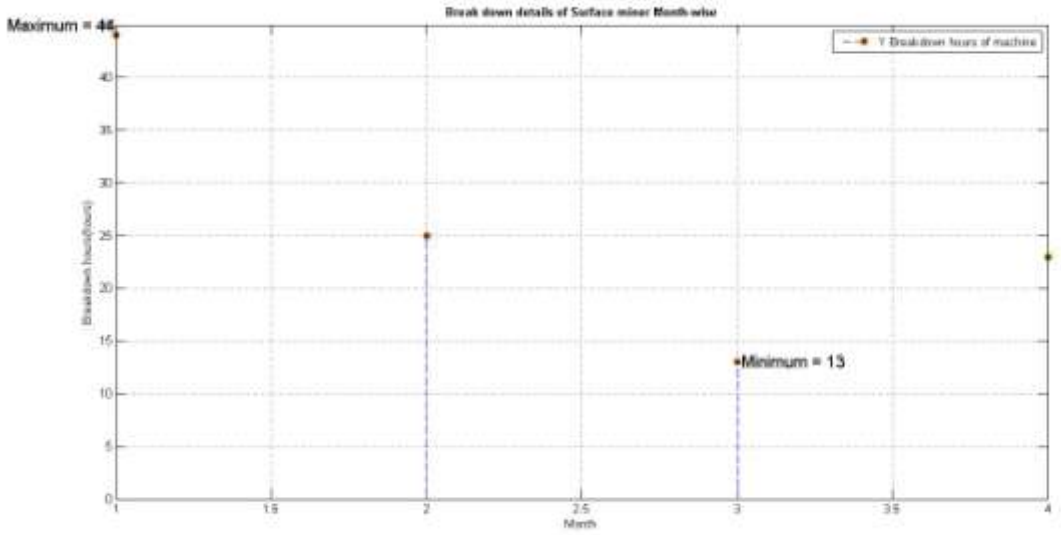

Figure 3.27 (b) Breakdown hours of L&T KSM-303(21) from Dec-2014 to Mar-2014

7) Idle hours graphs

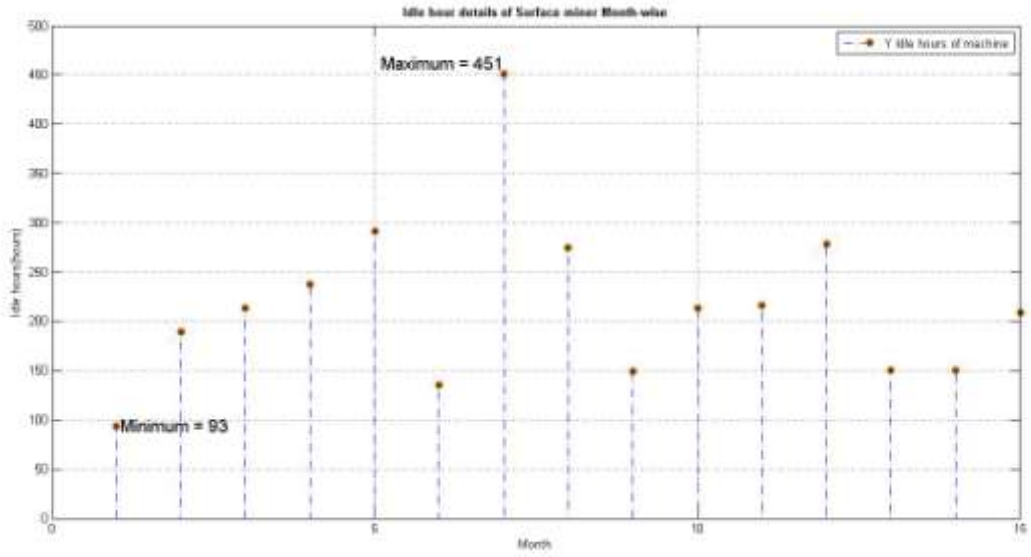

Figure 3.28 (a) Idle hours of L&T KSM-303(21) from Sep-2013 to Nov-2014

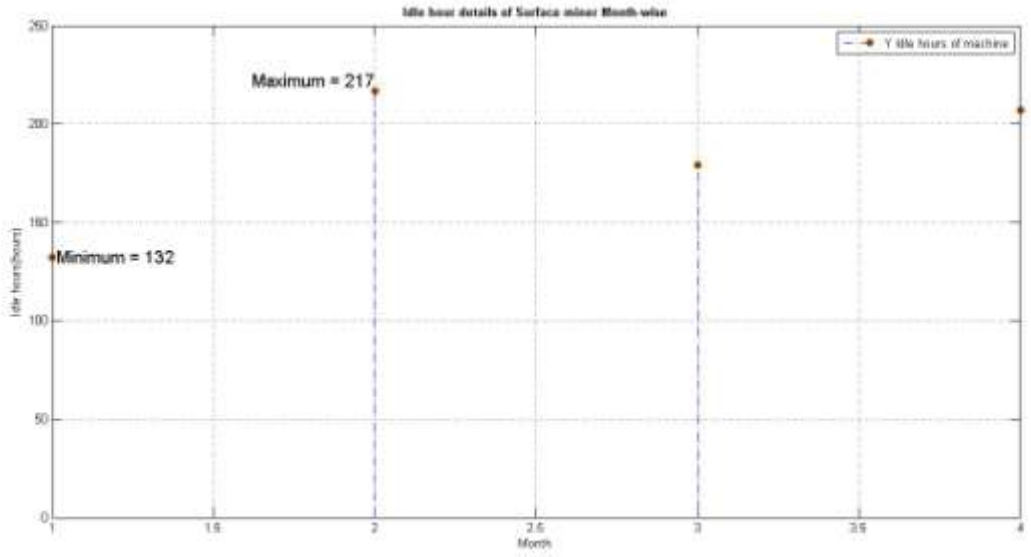

Figure 3.28 (b) Idle hours of L&T KSM-303(21) from Dec-2014 to Mar-2014

3.6 MONTHLY PERFORMANCE OF SURFACE MINER L&T KSM-303(20) IN SAMALESWARI OCP

Table 3.15: Performance of Surface miner (L&T-303(20)) at Samaleswari OCP (Year 2013-15)

MONTH	S/T	W/H	M/H	I/H	B/H		Availability	Utilisation	Target Production(T)	Achieved Production(T)	Performance rate	Theoretical OEE	Estimated OEE
					MARC	MCL							
Aug-13	552	191.00	21	269	57.00	14	83.33	34.60	230000	102543.85	44.58	0.13	0.47
Sep-13	720	419.00	31	230	22.00	18	90.14	58.19	300000	152476.29	50.83	0.27	0.65
Oct-13	744	365.00	31	313	26.00	9	91.13	49.06	310000	152487.35	49.19	0.22	0.59
Nov-13	720	360.00	29	306	17	8	92.50	50.00	300000	142587.51	47.53	0.22	0.60
Dec-13	744	435.00	31	277	1	0	95.70	58.47	310000	159542.21	51.47	0.29	0.66
Jan-14	744	419.00	30	282	8	5	94.22	56.32	310000	148453.47	47.89	0.25	0.64
Feb-14	672	295.00	25	336	12	4	93.90	43.90	280000	98772.80	35.28	0.15	0.53
Mar-14	744	345.00	29	257	88	25	80.91	46.37	310000	125412.21	40.46	0.15	0.53
Apr-14	720	460.00	29	116	113	2	80.00	63.89	300000	180378.11	60.13	0.31	0.68
May-14	744	499.00	31	168	28	18	89.65	67.07	310000	198451.21	64.02	0.38	0.72
Jun-14	720	529.00	28	129	29	5	91.39	73.47	300000	255271.04	85.09	0.57	0.81
Jul-14	744	534.00	31	135	44	0	89.92	71.77	310000	266254.64	85.89	0.55	0.80
Aug-14	192	115.00	8	65	4	0	93.75	59.90	80000	52312.00	65.39	0.37	0.70

MONTH	S/T	W/H	M/H	I/H	B/H		Availability	Utilisation	Target Production(T)	Achieved Production(T)	Performance rate	Theoretical OEE	Estimated OEE
					MARC	MCL							
Aug-14	552	350.00	22	138	35.00	7.00	88.41	63.41	230000	181927.50	79.10	0.44	0.73
Sep-14	720	488.00	31	175	26.00	0.00	92.08	67.78	300000	225510.46	75.17	0.47	0.76
Oct-14	744	501.00	26	90	127.00	0.00	79.44	67.34	310000	299526.91	96.62	0.52	0.76
Nov-14	720	426.00	26	131	131.00	6.00	77.36	59.17	300000	248026.72	82.68	0.38	0.69
Dec-14	744	470.00	30	173.5	70.50	0.00	86.49	63.17	310000	262524.63	84.69	0.46	0.74
Jan-15	744	412.00	25	184	123.00	0.00	80.11	55.38	310000	251220.37	81.04	0.36	0.67
Feb-15	672	408.00	25	118.5	116.50	4.00	78.35	60.71	280000	185116.10	66.11	0.31	0.67
Mar-15	744	470.00	25	130	119.00	0.00	80.65	63.17	310000	230795.00	74.45	0.38	0.70

S/T= Scheduled Time, W/H= Working Hour, M/H= Maintenance Hour, I/H= Idle Hour, B/H= Breakdown Hour

3.6.1 Graphs on monthly performance assessment of Surface miner L&T KSM-303(20) from (a) Aug-2013 to Aug-2014 (b) Aug-2014 to Mar-2015 at Samaleswari OCP have been presented in Figs.

1) Availability graphs

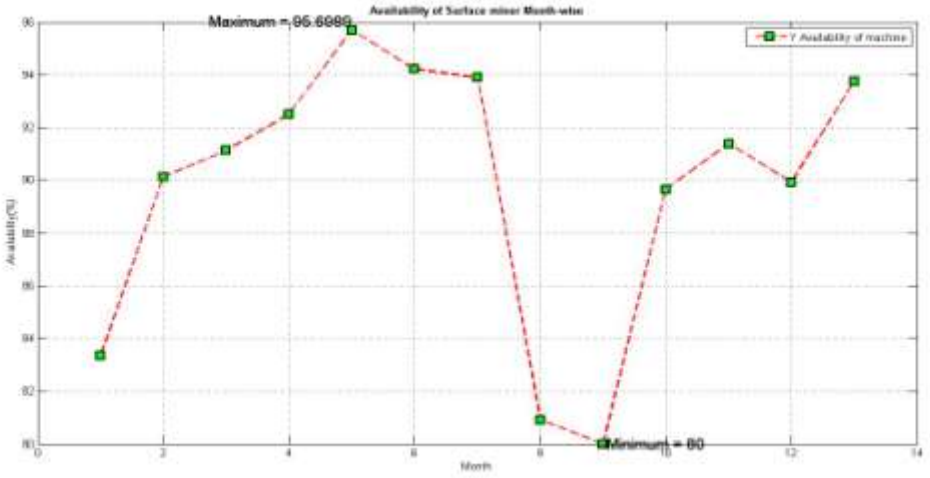

Figure 3.29 (a) Availability of L&T KSM-303(20) from Aug-2013 to Aug-2014

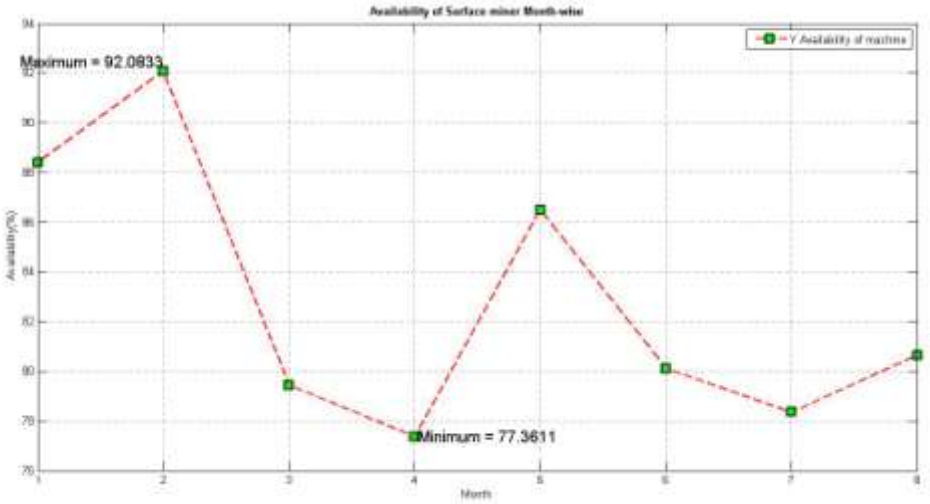

Figure 3.29 (b) Availability of L&T KSM-303(20) from Aug-2014 to Mar-2015

2) Utilisation graphs

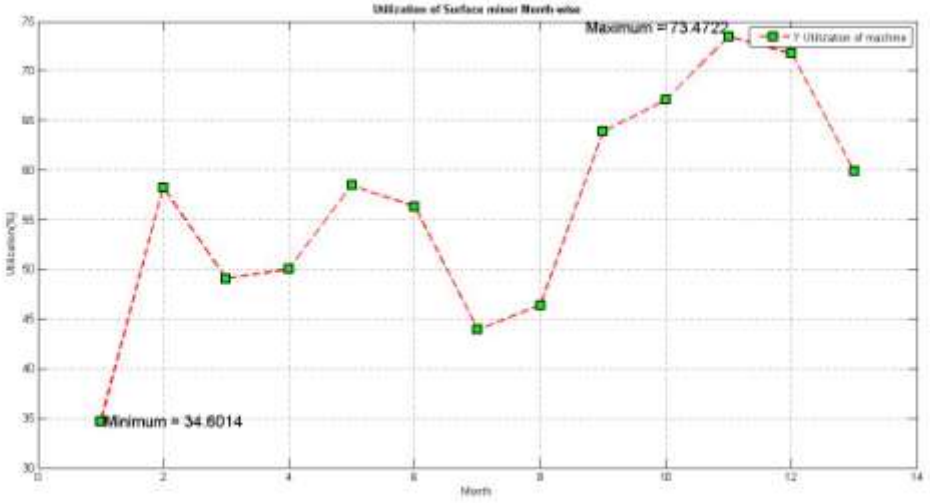

Figure 3.30 (a) Utilisation of L&T KSM-303(20) from Aug-2013 to Aug-2014

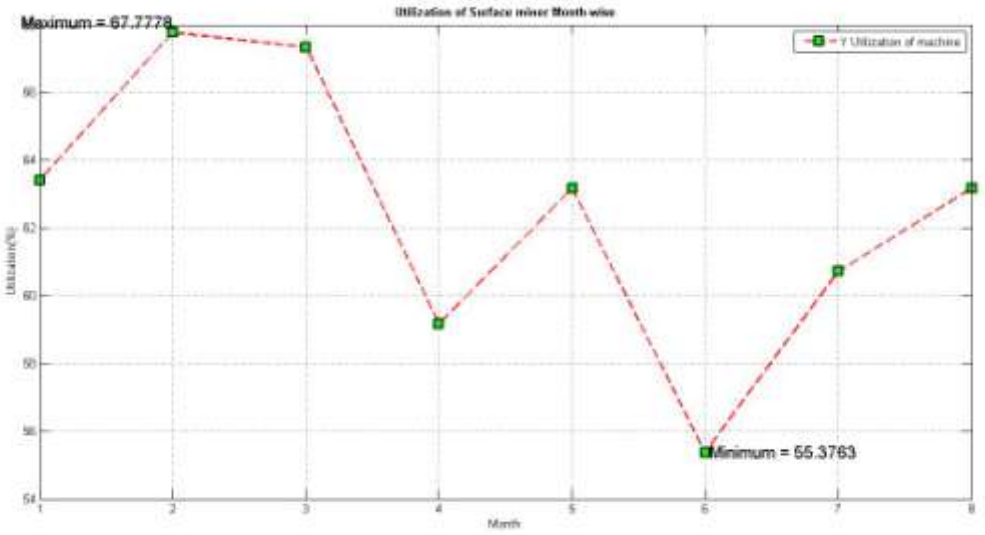

Figure 3.30 (b) Utilisation of L&T KSM-303(20) from Aug-2014 to Mar-2015

3) Performance rate graphs

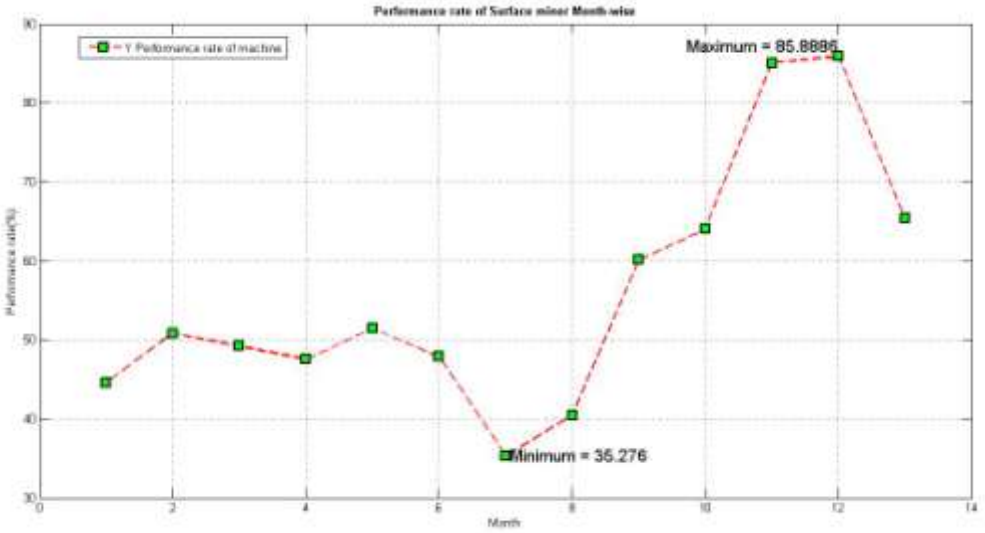

Figure 3.31 (a) Performance rate of L&T KSM-303(20) from Aug-2013 to Aug-2014

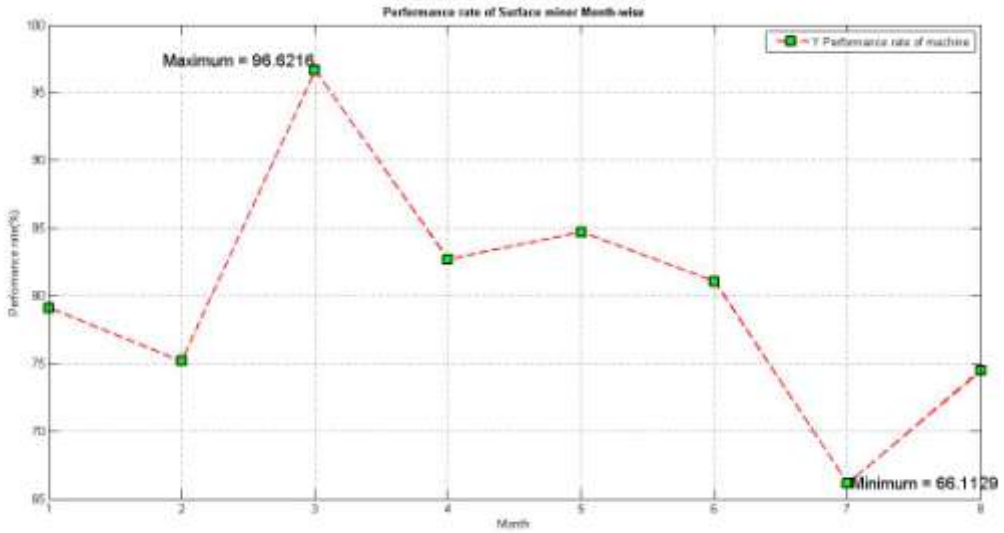

Figure 3.31 (b) Performance rate of L&T KSM-303(20) from Aug-2014 to Mar-2015

4) Theoretical OEE and Estimated OEE graphs

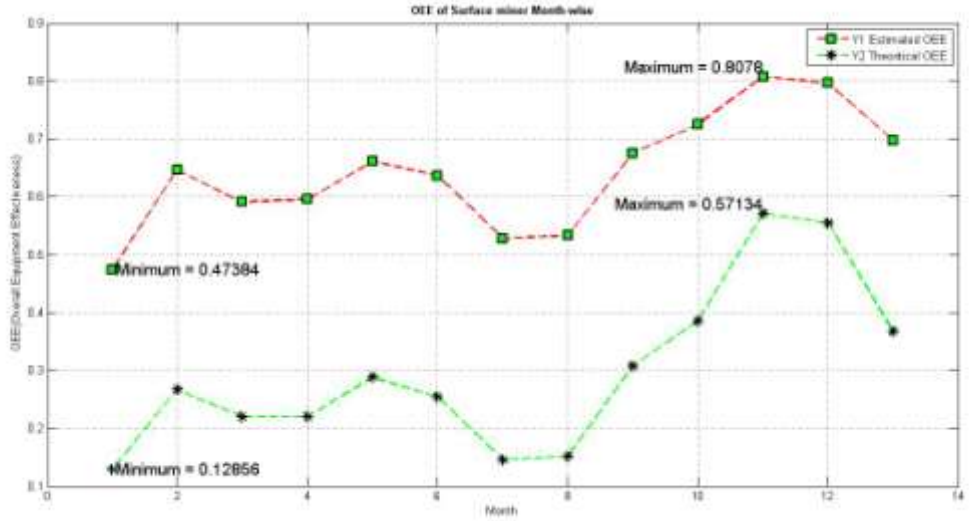

Figure 3.32 (a) Theoretical OEE and Estimated OEE of L&T KSM-303(20) from Aug-2013 to Aug-2014

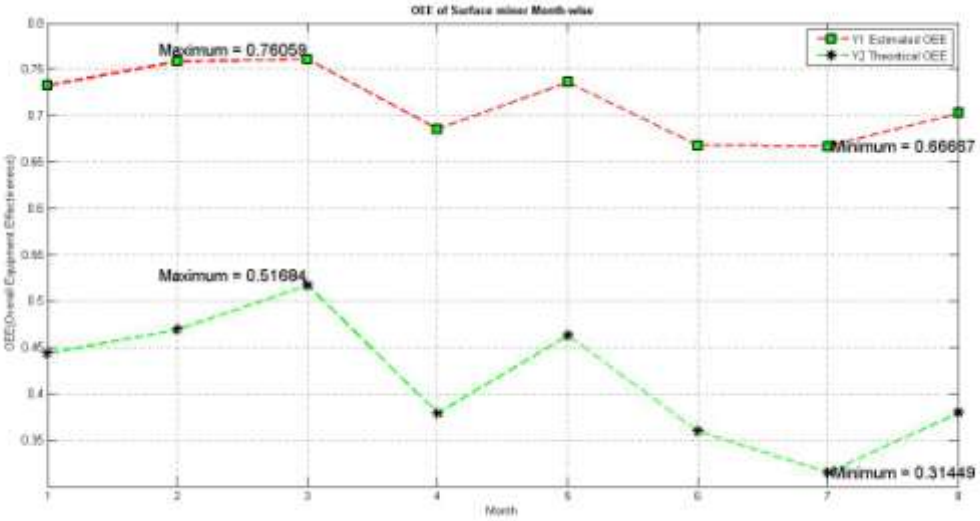

Figure 3.32 (b) Theoretical OEE and Estimated OEE of L&T KSM-303(20) from Aug-2014 to Mar-2015

5) Achieved production graphs

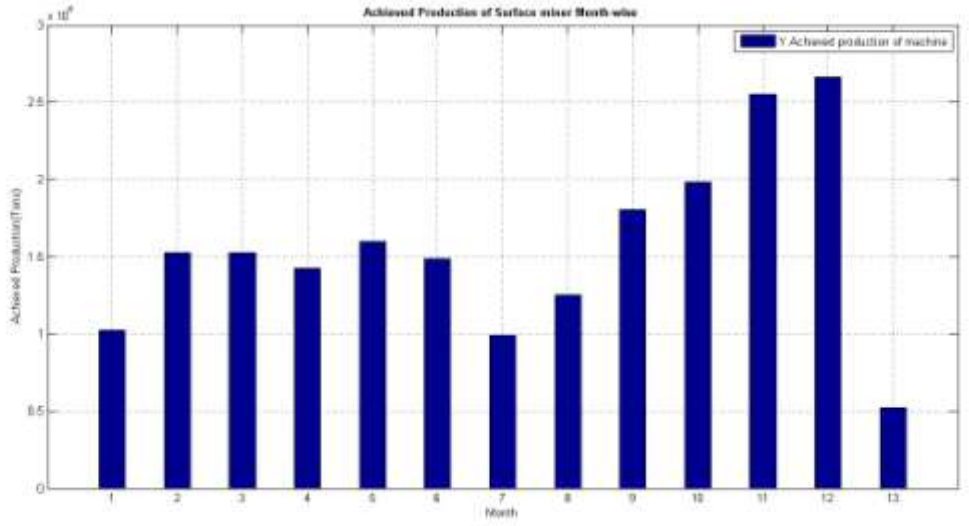

Figure 3.33 (a) Achieved production of L&T KSM-303(20) from Aug-2013 to Aug-2014

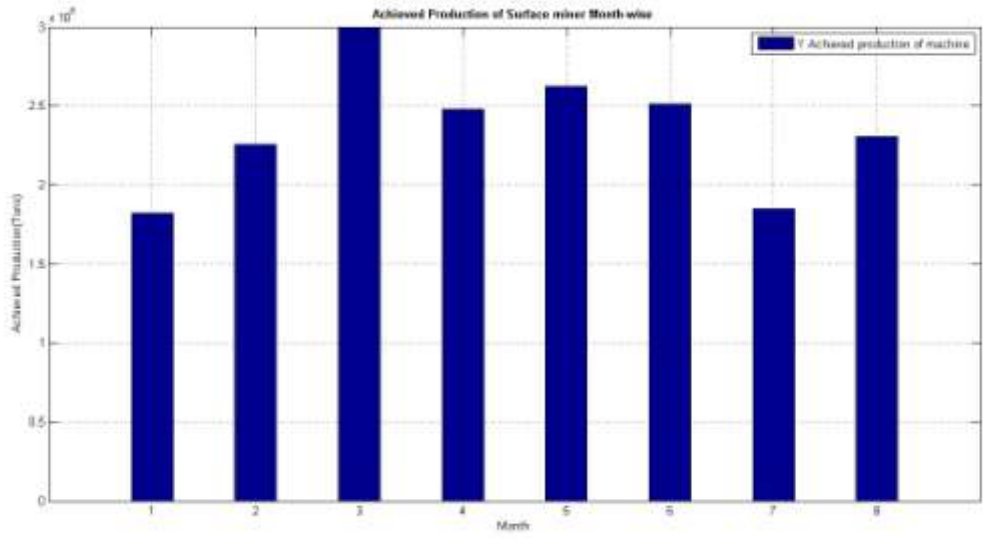

Figure 3.33 (b) Achieved production of L&T KSM-303(20) from Aug-2014 to Mar-2015

6) Breakdown hours graphs

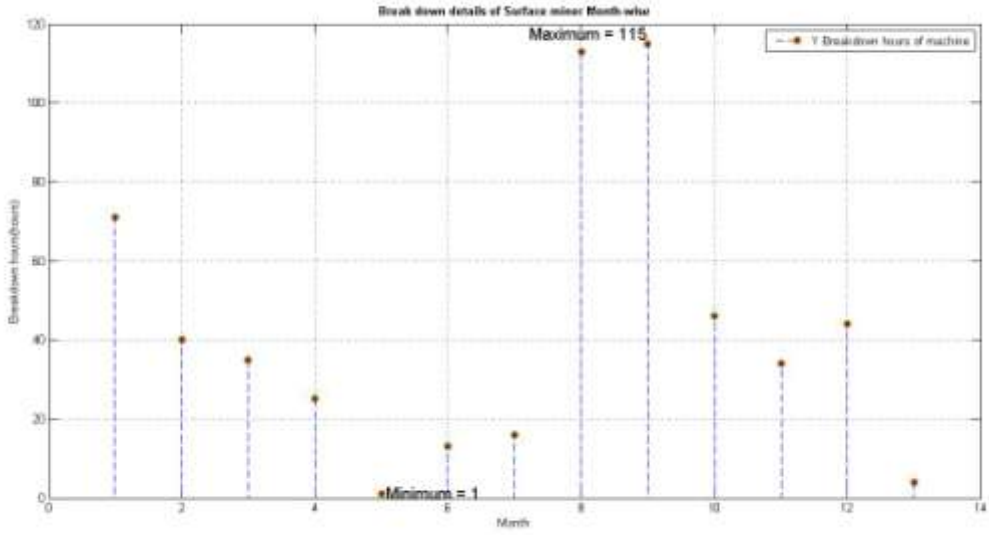

Figure 3.34 (a) Breakdown hours of L&T KSM-303(20) from Aug-2013 to Aug-2014

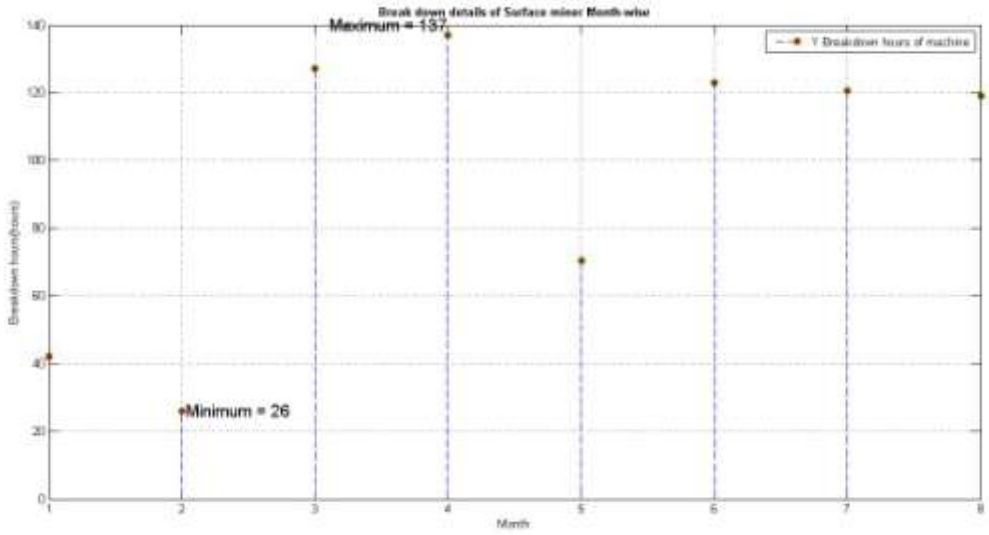

Figure 3.34 (b) Breakdown hours of L&T KSM-303(20) from Aug-2014 to Mar-2015

7) Idle hour graphs

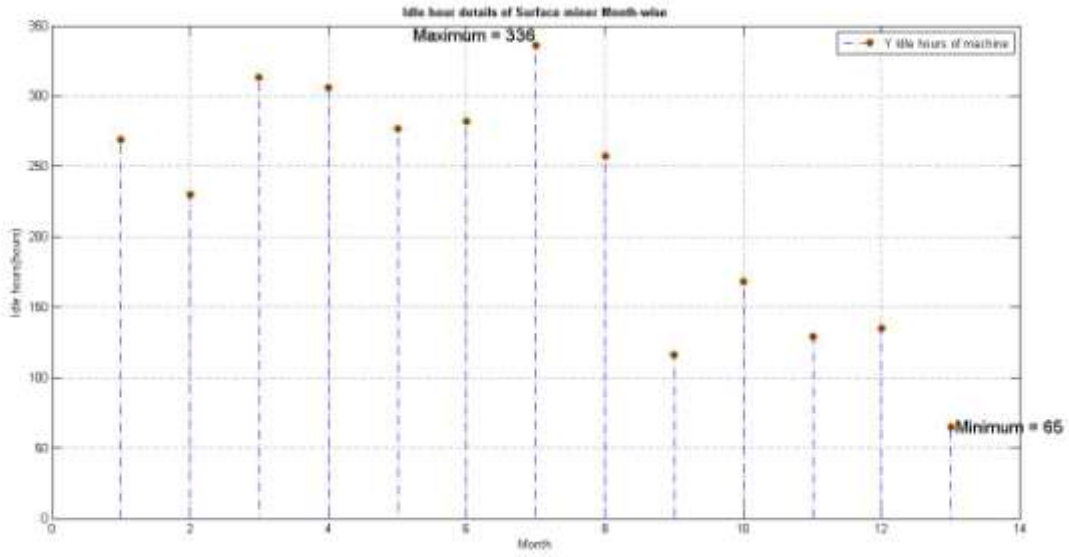

Figure 3.35 (a) Idle hour of L&T KSM-303(20) from Aug-2013 to Aug-2014

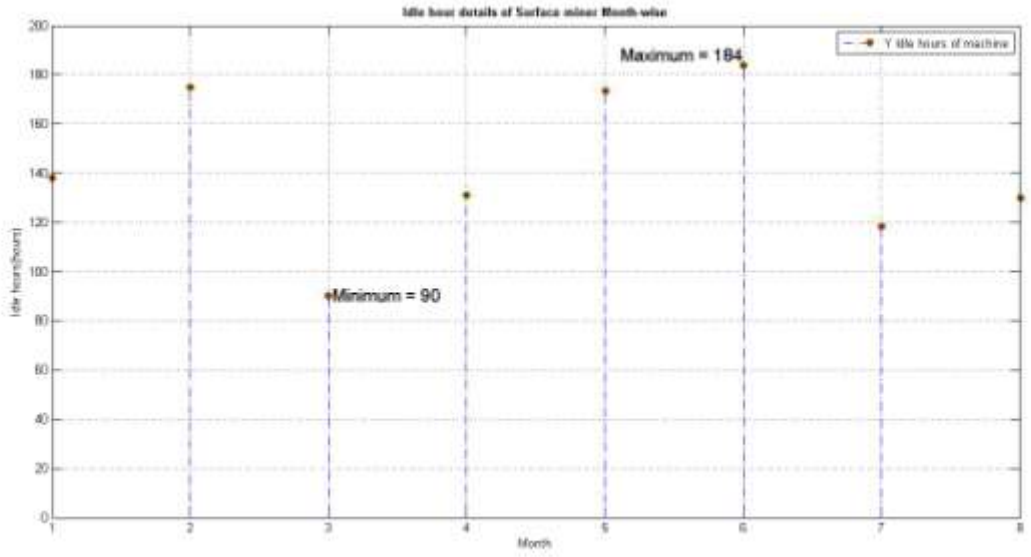

Figure 3.35 (b) Idle hour of L&T KSM-303(20) from Aug-2014 to Mar-2015

3.7 MONTHLY PERFORMANCE OF SURFACE MINER L&T KSM-303(24) IN SAMALESWARI OCP

Table 3.16: Performance of Surface miner (L&T-303(24)) at Samaleswari OCP (Year 2014-15)

MONTH	S/T	W/H	M/H	I/H	B/H		Availability	Utilisation	Target Production(T)	Achieved Production(T)	Performance rate	Theoretical OEE	Estimated OEE
					MARC	MCL							
Dec-13	264	80.50	12	171.5	0.00	0.00	95.45	30.49	110000	44429.00	40.39	0.12	0.45
Jan-14	744	401	31	294	18.00	0.00	93.41	53.90	310000	145276.21	46.86	0.24	0.62
Feb-14	672	354.	27	186.5	79.50	25.	80.43	52.68	280000	128451.67	45.88	0.19	0.58
Mar-14	744	442.	30	210.5	43.50	18	87.70	59.41	310000	185241.21	59.76	0.31	0.67
Apr-14	720	556.	30	108	25.00	1.00	92.22	77.22	300000	261042.00	87.01	0.62	0.83
May-14	744	575.	32	115	16.00	6.00	92.74	77.28	310000	201554.60	65.02	0.47	0.79
Jun-14	720	542.	30	135	12.00	1.00	94.03	75.28	300000	241709.00	80.57	0.57	0.82
Jul-14	744	538.	30	133.5	40.50	2.00	90.26	72.31	310000	296732.00	95.72	0.62	0.82
Aug-14	744	499.	33	204	8.00	0.00	94.49	67.07	310000	226006.00	72.91	0.46	0.76
Sep-14	720	497.	31	175	17.00	0.00	93.33	69.03	300000	194986.43	65.00	0.42	0.75
Oct-14	744	575	33	106	30.00	0.00	91.53	77.28	310000	252661.00	81.50	0.58	0.82
Nov-14	720	514.	32	119	49.00	6.00	87.92	71.39	300000	307530.00	102.51	0.64	0.82
Dec-14	480	351	21	91	17.00	0.00	92.08	73.13	200000	192240.00	96.12	0.65	0.83

MONTH	S/T	W/H	M/H	I/H	B/H		Availability	Utilisation	Target Production(T)	Achieved Production(T)	Performance rate	Theoretical OEE	Estimated OEE
					MARC	MCL							
Dec-14	264	182.	11	69	2.00	0.00	95.08	68.94	110000	92752.00	84.32	0.55	0.79
Jan-15	744	428.	26	172	118.	0.00	80.65	57.53	310000	241266.93	77.83	0.36	0.68
Feb-15	744	553.	33	120	28.	10.00	90.46	74.33	310000	305054.00	98.40	0.66	0.83
Mar-15	672	453.	23	110	86	0.00	83.78	67.41	280000	230411.00	82.29	0.46	0.75

S/T= Scheduled Time, W/H= Working Hour, M/H= Maintenance Hour, I/H= Idle Hour, B/H= Breakdown Hour

3.7.1 Graphs on monthly performance assessment of Surface miner L&T KSM-303(24) from (a) Dec-2013 to Dec-2014 (b) Dec-2014 to Mar-2015 at Samaleswari OCP have been presented in Figs.

1) Availability graph

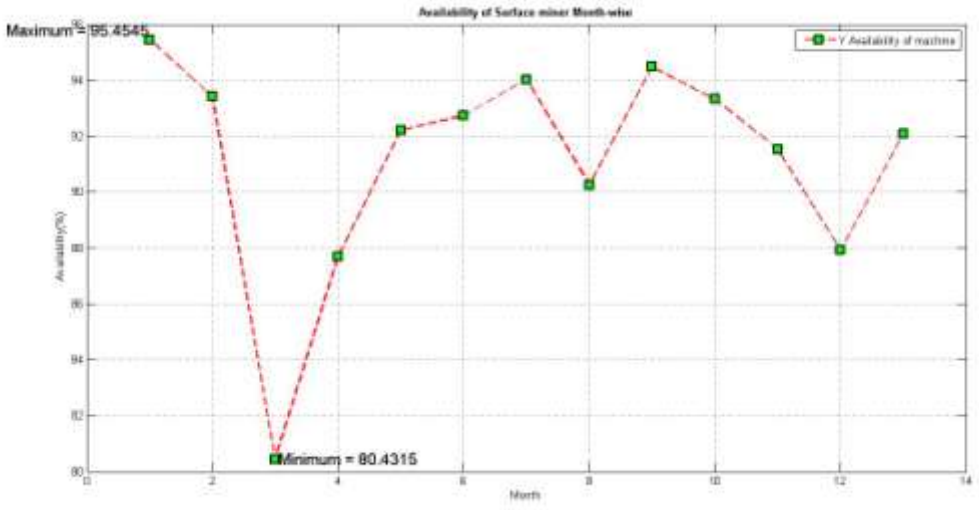

Figure 3.36 (a) Availability of L&T KSM-303(24) from Dec-2013 to Dec-2014

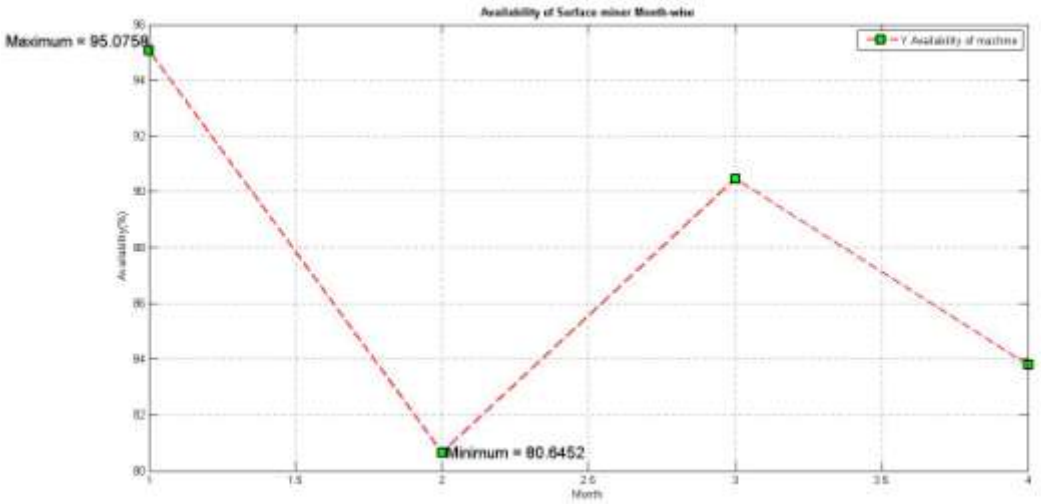

Figure 3.36 (b) Availability of L&T KSM-303(24) from Dec-2014 to Mar-2015

2) Utilisation graph

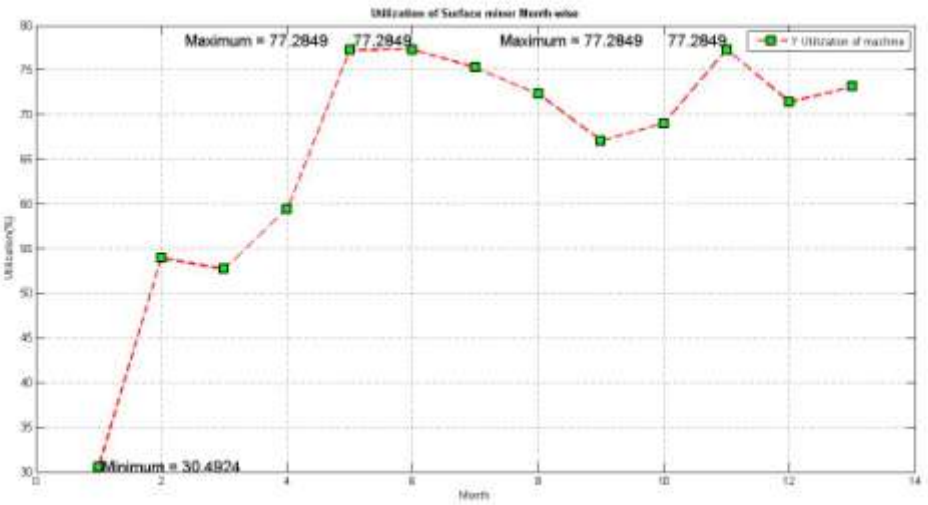

Figure 3.37 (a) Utilisation of L&T KSM-303(24) from Dec-2013 to Dec-2014

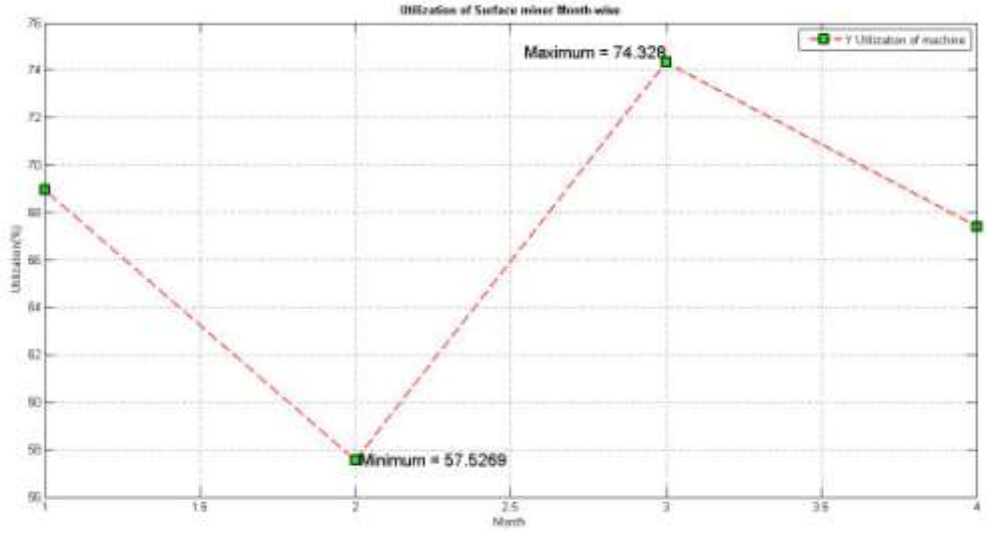

Figure 3.37 (b) Utilisation of L&T KSM-303(24) from Dec-2014 to Mar-2015

3) Performance rate graph

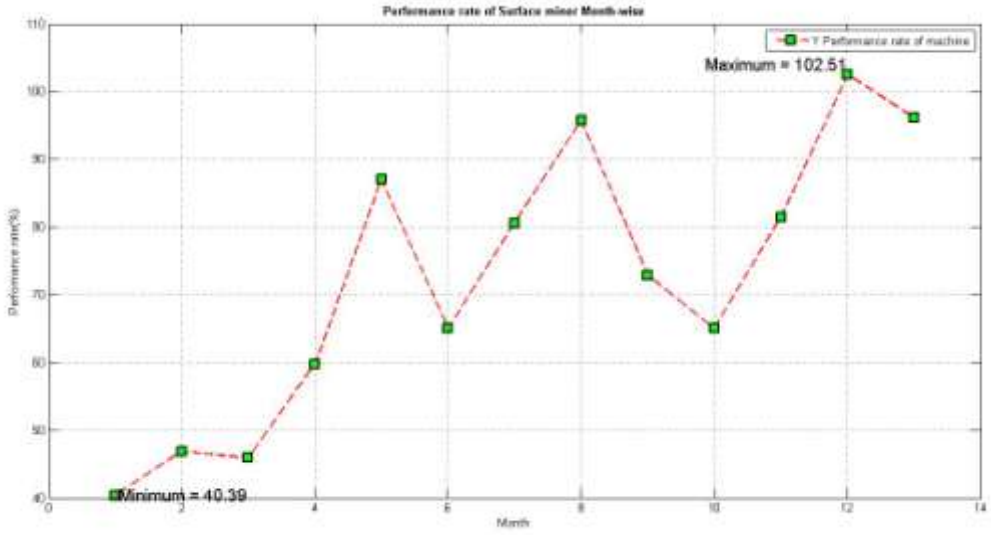

Figure 3.38 (a) Performance rate of L&T KSM-303(24) from Dec-2013 to Dec-2014

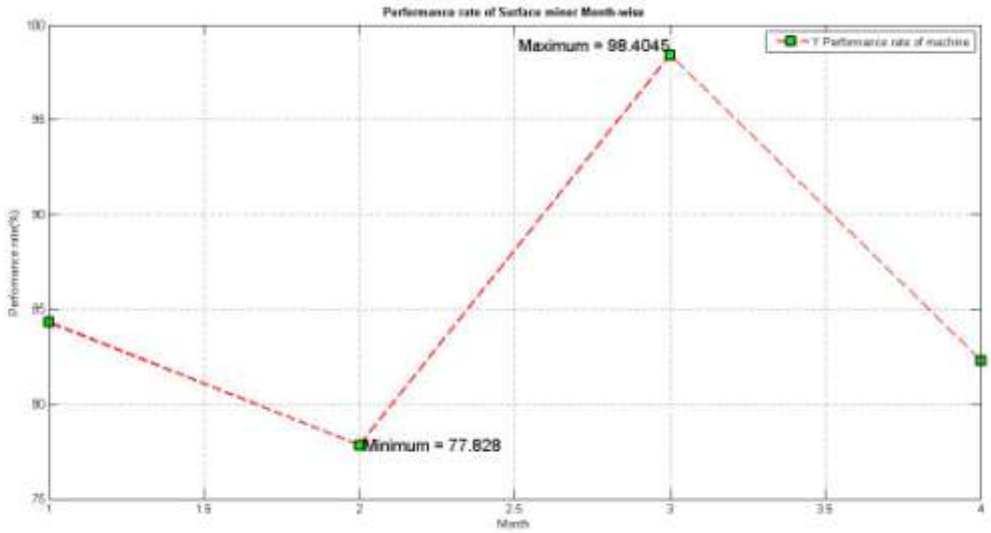

Figure 3.38 (b) Performance rate of L&T KSM-303(24) from Dec-2014 to Mar-2015

4) Theoretical OEE and Estimated OEE graphs

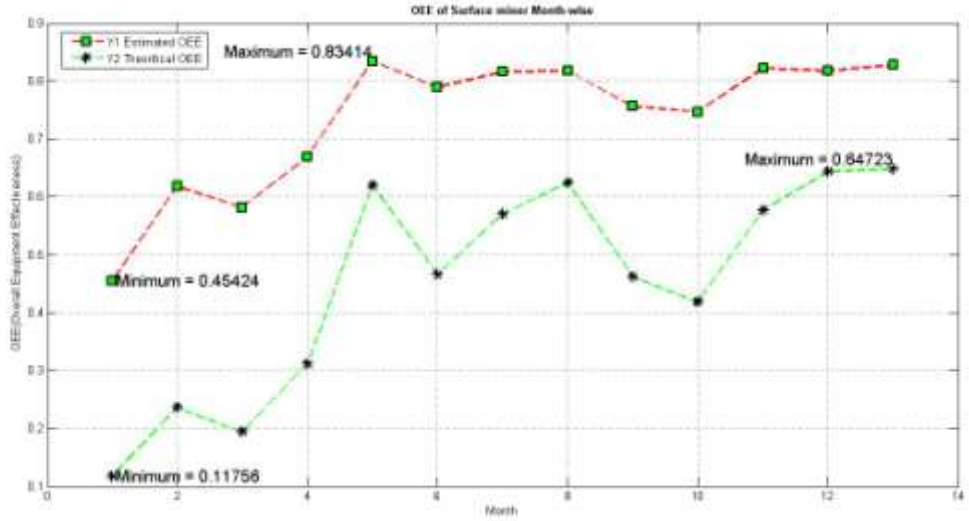

Figure 3.39 (a) Theoretical OEE and Estimated OEE of L&T KSM-303(24) from Dec-2013 to Dec-2014

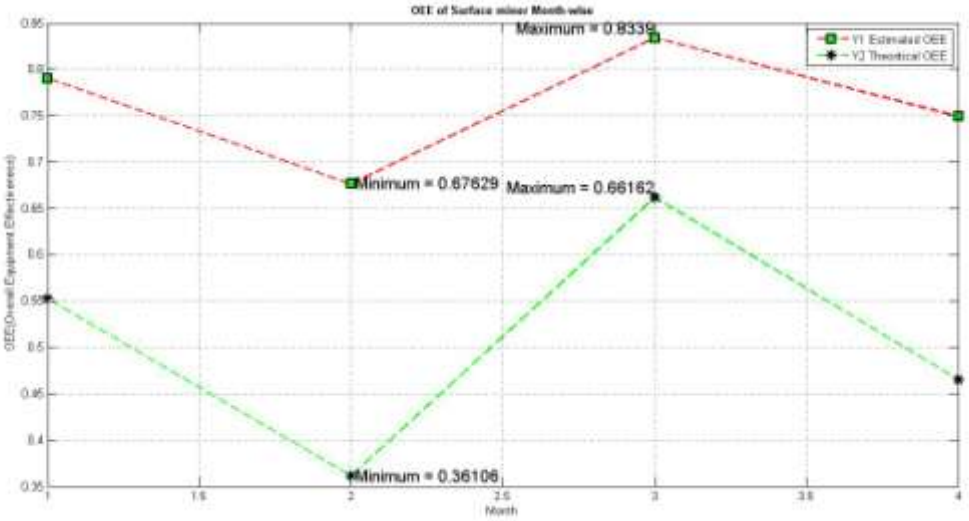

Figure 3.39 (b) Theoretical OEE and Estimated OEE of L&T KSM-303(24) from Dec-2014 to Mar-2015

5) Achieved production graphs

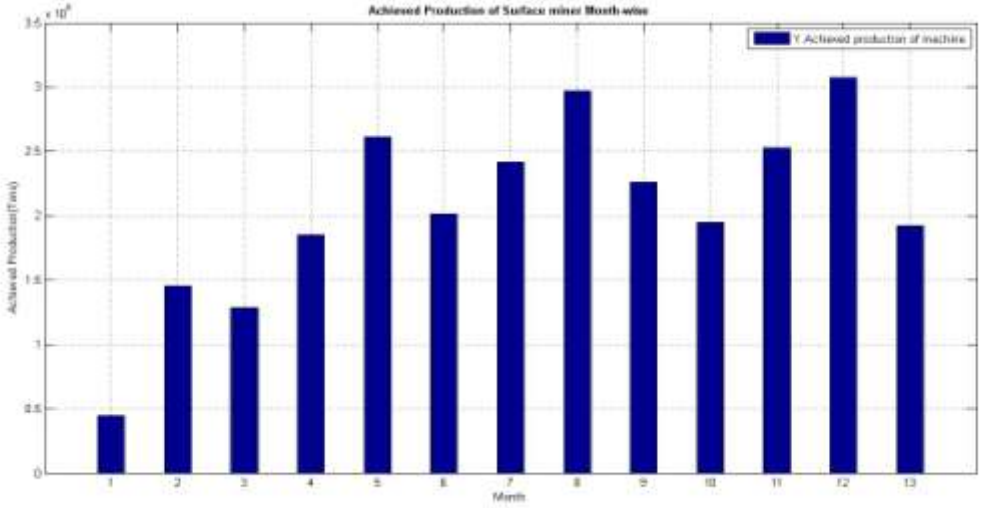

Figure 3.40 (a) Achieved production of L&T KSM-303(24) from Dec-2013 to Dec-2014

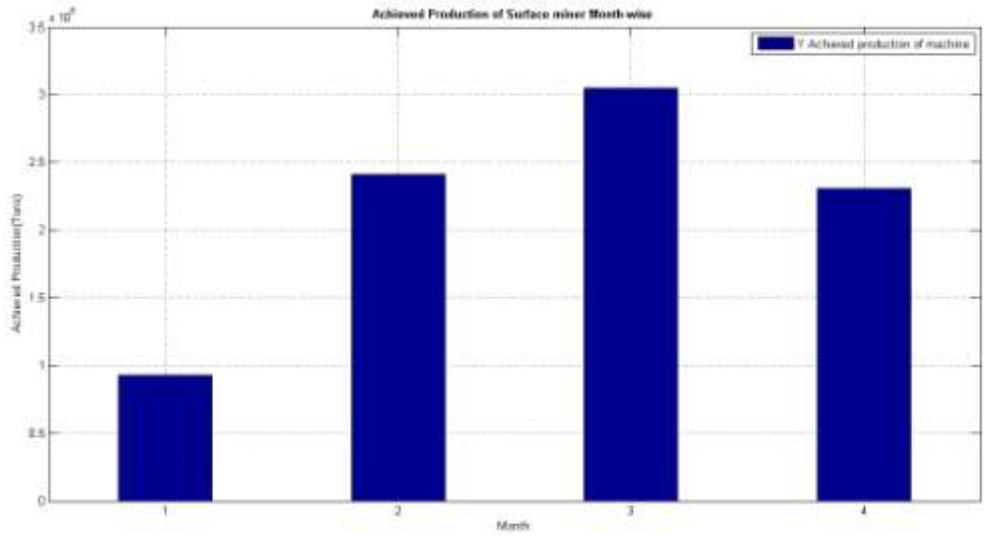

Figure 3.40 (b) Achieved production of L&T KSM-303(24) from Dec-2014 to Mar-2015

6) Breakdown hours graphs

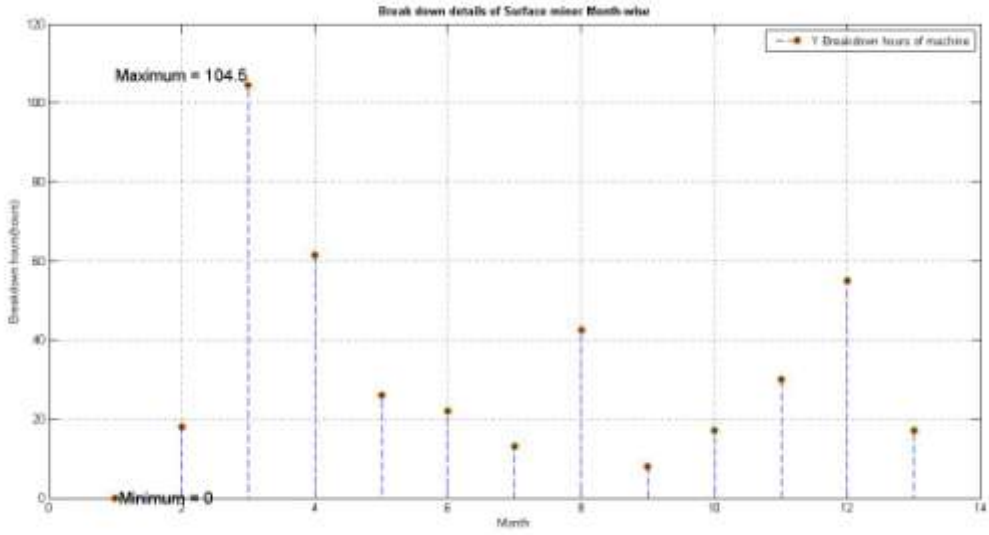

Figure 3.41 (a) Breakdown hours of L&T KSM-303(24) from Dec-2013 to Dec-2014

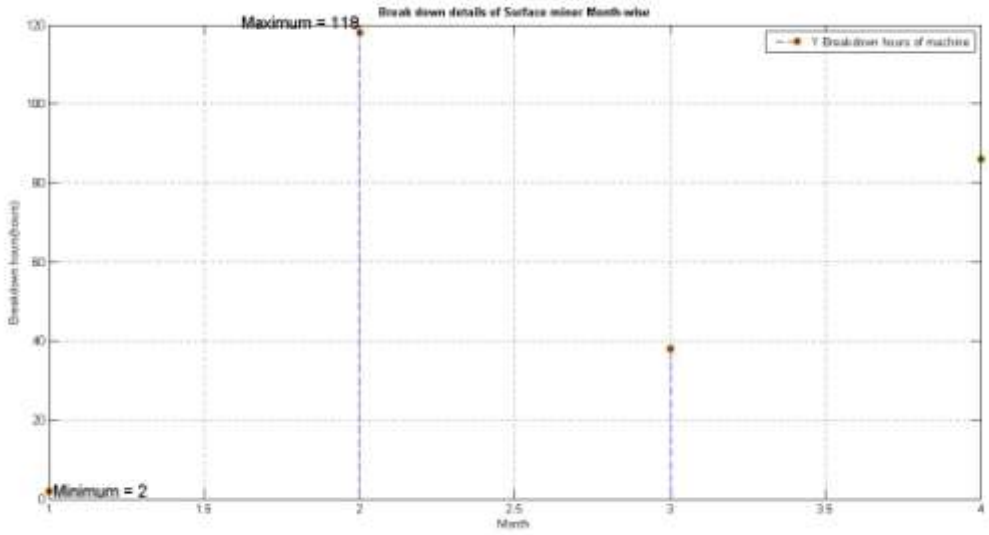

Figure 3.41 (b) Breakdown hours of L&T KSM-303(24) from Dec-2014 to Mar-2015

7) Idle hours graphs

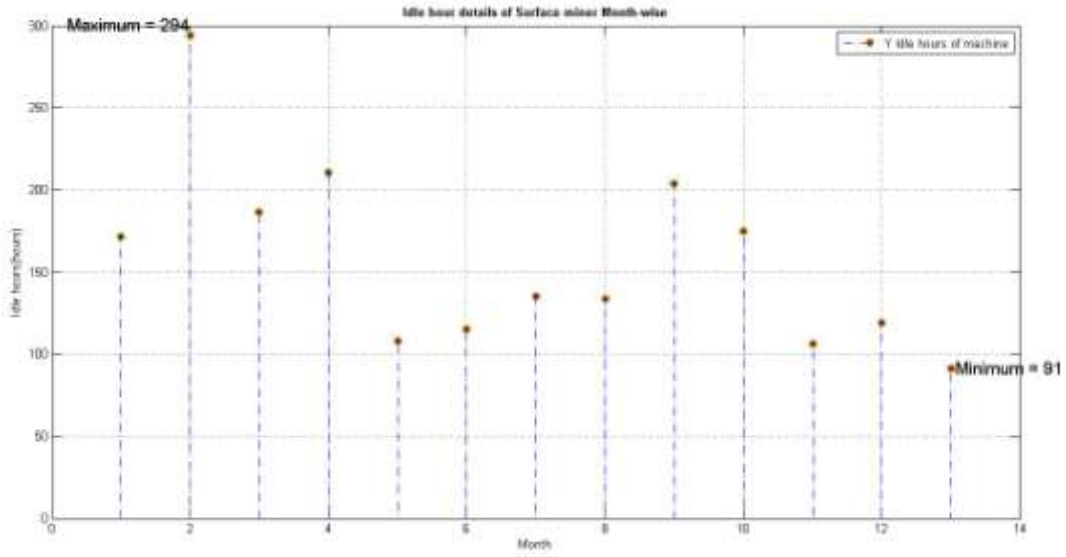

Figure 3.42 (a) Idle hours of L&T KSM-303(24) from Dec-2013 to Dec-2014

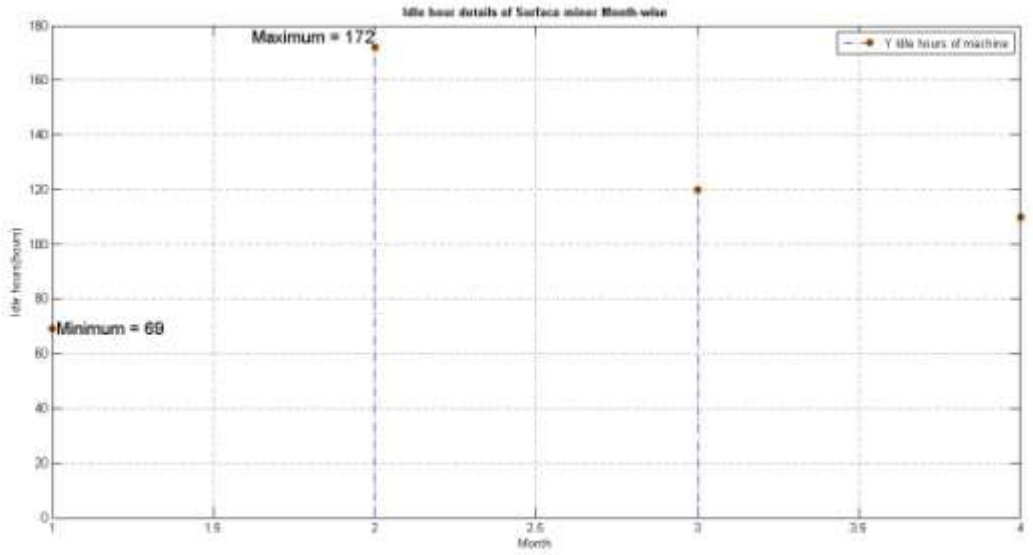

Figure 3.42 (b) Idle hours of L&T KSM-303(24) from Dec-2014 to Mar-2015

CHAPTER 4

RESULTS AND DISCUSSIONS

4 RESULTS AND DISCUSSIONS

RESULTS

4.1 Lakhanpur Opencast Mines (Daily Basis)

Surface Miner	Availability (%)		Utilisation (%)		Performance Rate (%)		Theoretical OEE		Proposed OEE		Achieved Production (Tons)		Breakdown hours		Idle hours	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
SM-468(Rungta)	88.33	12.50	70.83	12.5	96.72	20.01	0.56	0.003	0.75	0.13	14508	3001	21	0	12	1
SM-625(Rungta)	87.5	0	72.92	0	97.74	0	0.76	0	0.94	0	14661	0	24	0	7	1
SM-634(Rungta)	87.5	29.17	72.92	20.83	116.87	28.21	0.71	0.02	0.79	0.23	17531	4231	16	0	6.5	2
SM-336(Rungta)	87.5	0	77.08	0	116.48	0	0.786	0	0.824	0	17472	0	24	0	8	1
SM-L&T-303(15)	83.33	0	60.42	0	110.13	11.8	0.666	0	0.52	0	8260	885	24	0	12.7	2
SM-L&T-303(21)	100	64.58	75	29.17	166.33	32.2	0.94	0.091	0.82	0.377	12475	2415	3	0	17	2
SM-644(Nagarjuna)	85.42	64.58	66.67	25	91.96	53.68	0.524	0.134	0.723	0.342	9196	5368	3	0	10	4.5

If we consider the overall average performance the results are:

Maximum Availability is 77.88% ---------- L&T-303(021).	Minimum Availability is 48.78% ---------- SM-625(Rungta)
Maximum Utilisation is 57.99% ---------- SM-634(Rungta)	Minimum Utilisation is 37.15% ----------SM-625(Rungta)
Maximum Performance Rate is 92.51% ------- L&T-303(021).	Minimum Performance rate is 49.09% ----------SM-625(Rungta)
Maximum Theoretical OEE is 0.37 ---------- SM-634 (Rungta).	Minimum Theoretical OEE is 0.089 ---------- SM-625(Rungta)
Maximum Proposed OEE is 0.634 ---------- SM-634 (Rungta)	Minimum Proposed OEE is 0.4034 ---------- SM-625(Rungta)

4.2 Samaleswari Opencast mines (Daily Basis)

SM--L&T-KSM-303(024)	Month	Availability (%)		Utilisation (%)		Performance Rate (%)		Theoretical OEE		Proposed OEE		Achieved Production (Tons)		Breakdown hours		Idle hours	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
	January	100	0	75	0	130.08	0	0.935	0	0.8323	0	13008	0	24	0	24	1
	February	95.83	60.41	83.33	54.17	155	48.59	1.017	0.28	0.88	0.58	15500	4859	7	0	6	1
	March	95.83	54.17	87.5	33.33	134.34	40.29	1.07	0.072	0.92	0.37	13434	4029	11	0	8	1

If we consider the overall average performance the results are:

Maximum Availability is 90.52% ---------- February.	Minimum Availability is 81.65% ---------- January
Maximum Utilisation is 74.33% ---------- February	Minimum Utilisation is 55.11% ---------- January
Maximum Performance Rate is 98.40% ------- February.	Minimum Performance rate is 77.83% ------- January
Maximum Theoretical OEE is 0.6621 ---------- February.	Minimum Theoretical OEE is 0.3502 ---------- January
Maximum Proposed OEE is 0.7952 ---------- February	Minimum Proposed OEE is 0.6171 ---------- January

4.3 Lakhanpur Opencast mines(Monthly Basis)

Surface miner	Year	Availability (%)		Utilisation (%)		Performance Rate (%)		Theoretical OEE		Proposed OEE		Achieved Production (Tons)		Breakdown hours		Idle hours	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
SM L&T-KSM-303(021)	Year-1 (2013-14)	95.07 (Jan)	86.15 (Oct)	73.13 (Feb)	15.39 (Mar)	148.07 (Feb)	23.58 (Mar)	1.01 (Feb)	0.032 (Mar)	0.906 (Feb)	0.282 (Mar)	310023 (Feb)	46426 (Mar)	67 (Mar)	0 (Jan)	451 (Mar)	93 (Sep-13)
	Year-2 (2014-15)	92.83 (Feb)	88.77 (Dec)	68.46 (Dec)	57.94 (Mar)	137.85 (Dec)	105.85 (Mar)	0.837 (Dec)	0.56 (Mar)	0.851 (Dec)	0.7 (Mar)	280016 (Dec)	208383 (Mar)	44 (Dec)	13 (Feb)	217 (Jan)	132 (Dec)
SM L&T-KSM-303(015)	Year-1 (2012-13)	93.93 (Jul)	50 (Aug)	68.41 (Mar)	23.30 (Jul)	132.34 (Feb)	18.90 (Jun)	0.72 (Feb)	0.043 (Jun)	0.814 (Mar)	0.36 (Jul)	277087 (Feb)	38987.73 (Jun)	317 (Aug)	14 (Jul)	320.5 (Jun)	80 (Aug)
	Year-2 (2013-14)	95.52 (Aug)	66.97 (Feb)	54.63 (Nov)	28.51 (Aug)	105.2 (Nov)	54.94 (Aug)	0.54 (Nov)	0.15 (Aug)	0.73 (Nov)	0.47 (Aug)	220249 (Nov)	115025 (Aug)	191 (Feb)	8 (Nov)	449 (Aug)	176 (Feb)
	Year-3 (2014-15)	90 (Mar)	63.69 (Dec)	52.06 (Mar)	45.38 (Dec)	94.41 (Feb)	77.58 (Jan)	0.42 (Mar)	0.25 (Dec)	0.68 (Mar)	0.57 (Dec)	197668 (Feb)	162440 (Jan)	210 (Dec)	30 (Mar)	239 (Mar)	119 (Dec)

4.4 Samaleswari Opencast mines (Monthly Basis)

Surface miner	Year	Availability		Utilisation		Performance Rate		Theoretical OEE		Proposed OEE		Achieved Production (Tons)		Breakdown hours		Idle hours	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
SM L&T-KSM-303(020)	Year-1 (2013-14)	95.70 (Dec)	80 (Apr)	73.47 (Jun)	34.6 (Aug)	85.89 (Jul)	35.28 (Feb)	0.57 (Jun)	0.13 (Aug)	0.807 (Jun)	0.47 (Aug)	266254.64 (Jul)	98772.8 (Feb)	115 (Apr)	1 (Dec-13)	336 (Feb)	65 (Aug)
	Year-2 (2014-15)	92.08 (Sep)	77.36 (Nov)	67.78 (Sep)	55.37 (Jan)	96.62 (Oct)	66.11 (Feb)	0.52 (Oct)	0.314 (Feb)	0.76 (Oct)	0.67 (Feb)	299526.91 (Oct)	185116.1 (Feb)	137 (Nov)	26 (Sep)	184 (Jan)	90 (Oct)
SM L&T-KSM-303(024)	Year-1 (2013-14)	95.45 (Dec-13)	80.43 (Feb)	77.28 (May)	30.49 (Dec-13)	102.51 (Nov)	40.39 (Dec-13)	0.65 (Dec-14)	0.12 (Dec-13)	0.834 (Apr)	0.454 (Dec-13)	307530 (Nov)	44429 (Dec-13)	104.5 (Feb)	0 (Dec-13)	294 (Jan)	91 (Dec-14)
	Year-2 (2014-15)	95.08 (Dec-14)	80.65 (Jan)	74.33 (Feb)	57.53 (Jan)	98.40 (Feb)	77.83 (Jan)	0.66 (Feb)	0.36 (Jan)	0.83 (Feb)	0.36 (Jan)	305054 (Feb)	241266.9 (Jan)	118 (Jan)	2 (Dec-14)	172 (Jan)	69 (Dec-14)

DISCUSSIONS

The following discussions are made on the performance of Surface miners deployed at Samalewari OCP and Lakhanpur OCP based on the field studies and analysis conducted.

1. Daily Basis

(a) Lakhanpur Opencast project

- For surface miner SM-468(Rungta), the average %availability and %utilisation are observed to be 67.19% and 48.44% respectively. The average breakdown and idle hours are observed to be 3.85 and 4.5 respectively. The Theoretical and Estimated OEE are found to be 0.22 and 0.54 respectively.
- For surface miner SM-625(Rungta), the average %availability and %utilisation are observed to be 48.78% and 37.15% respectively. The average breakdown and idle hours are observed to be 9.44 and 2.79 respectively. The Theoretical and Estimated OEE are found to be 0.089 and 0.40 respectively.
- For surface miner SM-634(Rungta), the average %availability and %utilisation are observed to be 75.95% and 57.99% respectively. The average breakdown and idle hours are observed to be 1.125 and 4.31 respectively. The Theoretical and Estimated OEE are found to be 0.366 and 0.634 respectively.
- For surface miner SM-336(Rungta), the average %availability and %utilisation are observed to be 57.99% and 42.45% respectively. The average breakdown and idle hours are observed to be 6.25 and 3.73 respectively. The Theoretical and Estimated OEE are found to be 0.15 and 0.47 respectively.
- For surface miner SM-L&T-303(015), the average %availability and %utilisation are observed to be 69.33% and 38.99% respectively. The average breakdown and idle hours are observed to be 1.98 and 7.28 respectively. The Theoretical and Estimated OEE are found to be 0.15 and 0.45 respectively.
- For surface miner SM-L&T-303(021), the average %availability and %utilisation are observed to be 77.88% and 48.32% respectively. The average breakdown and idle hours are observed to be 0.125 and 7.09 respectively. The Theoretical and Estimated OEE are found to be 0.3481 and 0.5672 respectively.
- For surface miner SM-644(Nagarjuna), the average %availability and %utilisation are observed to be 75.25% and 46.17% respectively. The average breakdown and idle hours are observed to be 0.125 and 6.97 respectively. The Theoretical and Estimated OEE are found to be 0.2721 and 0.5367 respectively.

(b) Samaleswari Opencast project

- For surface miner SM--L&T-KSM-303(024) in the month of January, the average %availability and %utilisation are observed to be 81.65% and 55.11% respectively. The average breakdown and idle hours are observed to be 3.6 and 6.37 respectively. The Theoretical and Estimated OEE are found to be 0.3502 and 0.6171 respectively.
- For surface miner SM--L&T-KSM-303(024) in the month of February, the average %availability and %utilisation are observed to be 90.52% and 74.33% respectively. The average breakdown and idle hours are observed to be 1.24 and 3.88 respectively. The Theoretical and Estimated OEE are found to be 0.6621 and 0.7952 respectively.
- For surface miner SM--L&T-KSM-303(024) in the month of March, the average %availability and %utilisation are observed to be 83.78% and 67.41% respectively. The average breakdown and idle hours are observed to be 3.07 and 3.93 respectively. The Theoretical and Estimated OEE are found to be 0.4647 and 0.7182 respectively.

2. Monthly Basis

(a) Lakhanpur Opencast project

- For surface miner SM--L&T-KSM-303(015) in the year 2012-13, the average %availability and %utilisation are observed to be 76.97% and 44.79% respectively. The average breakdown and idle hours are observed to be 64.33 and 154.17 respectively. The Theoretical and Estimated OEE are found to be 0.27 and 0.59 respectively.
- For surface miner SM--L&T-KSM-303(015) in the year 2013-14, the average %availability and %utilisation are observed to be 80.75% and 39.83% respectively. The average breakdown and idle hours are observed to be 43.08 and 271 respectively. The Theoretical and Estimated OEE are found to be 0.23 and 0.55 respectively.
- For surface miner SM--L&T-KSM-303(015) in the year 2014-15 (up to March), the average %availability and %utilisation are observed to be 80.66% and 49.92% respectively. The average breakdown and idle hours are observed to be 95.5 and 201.25 respectively. The Theoretical and Estimated OEE are found to be 0.35 and 0.64 respectively.
- For surface miner SM--L&T-KSM-303(021) in the year 2013-14, the average %availability and %utilisation are observed to be 91.84% and 58.07% respectively. The average breakdown and idle hours are observed to be 21.17 and 216.63 respectively. The Theoretical and Estimated OEE are found to be 0.57 and 0.75 respectively.
- For surface miner SM--L&T-KSM-303(021) in the year 2014-15 (up to March), the average %availability and %utilisation are observed to be 90.97% and 62.91% respectively. The average breakdown and idle hours are observed to be 26.25 and 183.75 respectively. The Theoretical and Estimated OEE are found to be 0.71 and 0.80 respectively.

(b) Samaleswari Opencast project

- For surface miner SM--L&T-KSM-303(024) in the year 2013-14, the average %availability and %utilisation are observed to be 91.20% and 65.88% respectively. The average breakdown and idle hours are observed to be 31.89 and 157.62 respectively. The Theoretical and Estimated OEE are found to be 0.43 and 0.74 respectively.
- For surface miner SM--L&T-KSM-303(024) in the year 2014-15 (up to March), the average %availability and %utilisation are observed to be 87.49% and 67.05% respectively. The average breakdown and idle hours are observed to be 61 and 117.75 respectively. The Theoretical and Estimated OEE are found to be 0.5 and 0.76 respectively.
- For surface miner SM--L&T-KSM-303(020) in the year 2013-14, the average %availability and %utilisation are observed to be 89.73% and 56.39% respectively. The average breakdown and idle hours are observed to be 42.85 and 221.77 respectively. The Theoretical and Estimated OEE are found to be 0.28 and 0.65 respectively.
- For surface miner SM--L&T-KSM-303(020) in the year 2014-15 (up to March), the average %availability and %utilisation are observed to be 82.86% and 62.52% respectively. The average breakdown and idle hours are observed to be 95.63 and 142.5 respectively. The Theoretical and Estimated OEE are found to be 0.41 and 0.71 respectively.

CHAPTER 5

CONCLUSION AND SCOPE FOR FUTURE STUDIES

5 CONCLUSION AND SCOPE FOR FUTURE STUDIES

CONCLUSION

The performance of different operating models of surface miner deployed at Lakhanpur opencast project and Samaleswari opencast project of Mahanadi Coalfields Limited (MCL) was analysed on daily and monthly basis.

The assessment is carried out by analysing the %availability, %utilisation and Overall Equipment Effectiveness (OEE) of the surface miner. Overall Equipment Effectiveness (OEE) is a simple tool developed to measure the performance against the capability of the equipment. It takes into consideration the most common and important sources of productivity loss, which are called six big losses. In this assessment, for calculating OEE, Availability (A), Utilisation rate (U) and Performance rate (Pr) are given different weights. These weights are taken after considering the relative importance of the above parameters using Analytic Hierarchy process (AHP).

The assumed weights are as follows: availability: 0.2, utilisation: 0.7 and performance rate: 0.1 for calculating on daily basis and for calculating on monthly basis we assume weights as follows: availability: 0.3, utilisation: 0.5 and performance rate: 0.2.

From the above we have,

$$OEE(Daily\ basis) = (A^{0.2}) \times (Pr^{0.1}) \times (U^{0.7})$$

$$OEE(Monthly\ basis) = (A^{0.3}) \times (Pr^{0.2}) \times (U^{0.5})$$

SCOPE FOR FUTURE STUDIES

- In future, a software can be developed to calculate all these assessments in a nutshell. In addition to these we can also add financial assessment.
- Artificial Neural Networks can be used to predict the future performance of the surface miner.

CHAPTER 6

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6 REFERENCES

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